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A Soil Survey of the Lakes District. Western Australia.

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SUMMARY AND CONCLUSIONS.

1. The general physiographic and climatic conditions of the Lakes District and details of the soil types and their chemical, physical and agricultural properties are given.

2. The soil survey covered an area of 228,667 acres over a distance of 70 miles where the average annual rainfall ranges from nearly 14 inches to somewhat less than 11 inches.

3. Ten soil series, subdivided into 20 types and phases, were recognised and named. In addition, a number of miscellaneous types and sub-types were described.

4. The principal soils are typical of the grey and brown solonised soil zone or "mallee" zone.

5. The soil types have been related to the first, second and third classes used under the system of land classification adopted by the Department of Lands and Surveys.

6. The chief potential agricultural soils of the district are those of the salmon gum woodland (32,595 acres), the gimlet thickets (6,696 acres) and the better class mallee scrub (37,533 acres) in which salinity is not high. These soils, covering 76,824 acres in the area examined, resemble the soils of other parts of the wheat belt under similar rainfall conditions.

7. Problem soils are those of the morrel woodland (59,700 acres) and areas of other groups where excessive salinity occurs (28,269 acres).

8. Other soils of low agricultural value are those of the heath and wodjil plains (36,521 acres) and the low-lying, lakey country (18,323 acres). Small lakes and rock outcrops account for 9,030 acres.

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9. The woodland and mallee scrub soils generally are rich in potash, lime and magnesia, normally low in nitrogen and humus and extremely deficient in phosphate.

10. Apart from the morrel woodland and saline areas, the soils are suitable for general mixed farming, with stock raising and wheat production as the chief activities. There is evidence that the problem soils may improve under a programme of pasture production and stock raising. Transport difficulties are serious.

11. Over-stocking and over-cultivation must be carefully avoided to prevent soil erosion and land deterioration.

I. INTRODUCTION.

Following the reconnaissance survey of the main portion of the 3,500 Farms Scheme south of Southern Cross (Teakle, 1939), a more detailed examination was made of an area known as the Lakes District, which lies east of Newdegate but west of No. 1 Rabbit Proof Fence. The location of this area is shown in Figure 1. Settlement in this district was commenced in 1928 as part of the 3,500 Farms Scheme under agreement with the Development and Migration Commission, and good progress was made in the early years when some 203 holdings were selected and improvements initiated. Although the northern portion of the settlement was 55 miles from the railway at Kondinin, and Lake King at the south was 40 miles from the rail head at Newdegate, the apparent prospects for wheat farming attracted many settlers and available holdings were quickly disposed of. It was anticipated that railway services for the proposed 3,500 Farms Scheme would soon be available.

Unfortunately, the agricultural conditions in the Salmon Gums district and the results of the soil examinations to the eastwards were discouraging and the State Government took steps to ascertain the extent of the salinity problem in the Lakes District. A brief reconnaissance, made in May, 1930, showed that soil salinity was a problem of some magnitude and in consequence a more detailed soil survey was commenced in August, 1930. Field work was completed by the end of May, 1931.

The results of this survey served to define the soil conditions in the area, and to give a general picture of the distribution of soil types and the incidence of soil salinity in the district. Less attention was paid to the recognition of soil types in this survey than in subsequent work as the foremost question was that of the incidence of soil salinity. In an area devoted to an extensive type of farming, it is impossible to undertake a soil survey which will give a very detailed picture for every farm. For this purpose a much closer soil examination would have to be made, and such a programme is unwarranted, except, of course, for special investigational work such as may be conducted on research stations. In this survey, an endeavour was made to obtain sufficient data to construct a map which would show the distribution of the main soil types and the general severity of the salinity problem on each farm in the shortest possible time, to meet the needs of those administering the district. Subsequent experience showed that the methods adopted adequately met these requirements and that, intelligently interpreted, the maps prepared should be a valuable guide to the conduct of farming operations in the surveyed area.

The soil survey was used by the Agricultural Bank as a basis for reconstruction of the settlement in 1935 ("West Australian," 25th September, 1935). At that time there were 101 farmers under the Agricultural Bank and eight free

settlers in the district. Practically every settler desired to remain in the district. Reconstruction proposals involved the linking up of holdings and the provision of additional improvements, so that there would be sufficient land for carrying from 800 to 1,000 sheep and an adequate area of suitable soils for a limited programme of wheat production. It was estimated that about £140,000 for additional improvements would be required for the realisation of this purpose.

Fig. 1.—Sketch map of the Lakes District showing the rail heads at Hyden and Newdegate and the No. 1 Rabbit Proof Fence. The portion examined in the course of the soil survey is included within the outlined area adjacent to the lake system. The location of sites from which type samples were obtained is shown by the small circles each of which is identified by the serial number of the surface sample. Scale: 1 inch = 14.7 miles (approx.).

II. PHYSIOGRAPHY AND GEOLOGY.

The main settlement lies in a valley running about N.N.W. and S.S.E. in direction and extends over a distance of 70 miles from Lake O'Connor in the north to Lake Pallarup in the south. There can be little doubt that the area represents an old river valley formed in pre-historic times (but during the Tertiary period) when the climate was wetter. With subsequent desiccation, the river channel has been reduced to a chain of salinas, or salt lakes as they are called in Western Australia, and low-lying lakey country. The chief salinas in

the chain have been named and, from north to south, include Lakes O'Connor, Carmody, Gulson, Varley, Camm, King, Milarup and Pallarup. Short tributaries of the old river system are represented by a number of areas of timber country running eastward from the main valley. The most definite of these tributary valleys is occupied by Lake Newton, Lake Kathleen and Lake Ace. No surface flow of water now occurs in these channels.

The salinas and low-lying country generally occupy the extreme western side of the valley, and the farming lands run eastward from these formations to the heath and wodjil country of the old peneplain. The facts that the salinas lie against the western side where the rise is fairly abrupt to the gravelly sandplains of the old peneplain formation, and the main valley floor extends generally from 1-3 miles to the eastward, would suggest that this area had either been tilted slightly downward to the west or that prevailing westerly winds had filled the eastern portion of the valley with detritus, thus forcing the channel against the western shore.

Information derived from railway surveys at Lake Grace and Newdegate indicates that the elevation of the area in the south ranges from about 900 feet on the valley floor, represented by the salinas, to about 1,100 feet on the peneplain. Further north the elevation is somewhat higher as the salinas in the vicinity of Lake O'Connor are about 1,000 feet above sea level.

A diagrammatic representation of a vertical section of the area is shown in Figure 2. As information for Lake King is not available, the data from the Lake Grace Railway survey have been used to illustrate the changes in elevation across the section.

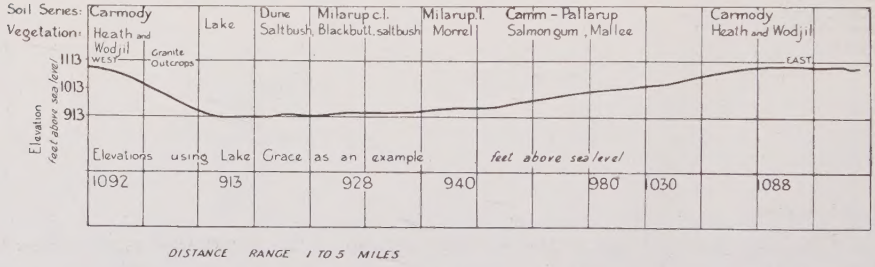

Fig. 2.—Diagrammatic representation of a vertical section of the Lake King valley showing the lake against the relatively steep western side of the valley and the valley floor gradually rising to the east. As no levels are available for Lake King, figures from Lake Grace are quoted as representative of a similar catena. (Figures kindly supplied by Mr. McCulloch of the W.A. Government Railways.)

The valley is senile and both the eastern and western slopes are buttressed by the granitic or gneissic bosses exposed by the erosive agencies which lead to its formation.

The principal geological formations of the area are the pre-Cambrian granites and gneisses typical of the wheat belt generally. As in the more northern agricultural areas, basic dykes or other types of intrusive rocks occur in the pre-Cambrian complex, and give rise to variations in the soil conditions.

While there is little concrete geological evidence, the nature of the soil types in the southern portion of the district suggests the presence of sandstone formations, possibly of the Miocene group observed in the Salmon Gums district, in addition to the pre-Cambrian rocks.

III. CLIMATE.

The climate of the area is typical of the southern wheat belt. The rainfall ranges from an average of nearly 14 inches in the south to about 10½ inches in the north. While the bulk of the precipitation occurs in the winter, a certain amount of summer rain is received and should greatly improve the prospects for pasture production and stock raising as compared with the northern areas of similar annual rainfall. Winter frosts are common but the summer temperatures are tempered somewhat by the southern ocean.

Table 1 gives meteorological information supplied by the Divisional Meteorologist regarding three stations representing the district, and a comparison with the records from the Merredin Research Station and the Salmon Gums Research Station.

TABLE 1.

RAINFALL RECORDS FOR STATIONS IN THE LAKES DISTRICT IN COMPARISON WITH OTHER DISTRICTS.

Station.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Emu Rock—33 years to 1938	43	34	80	82	139	130	141	158	78	69	67	34	1,055
Lake King—10 years to 1939	93	34	156	73	167	161	188	173	90	133	69	44	1,381
Lake Varley—10 years to 1939	112	42	451	90	162	155	172	178	100	141	62	27	1,392
Merredin Research Station—27 years to 1938	52	44	105	89	127	181	180	152	84	78	41	50	1,183
Salmon Gums Research Station—13 years to 1938	82	55	142	97	134	154	150	165	92	104	96	62	1,333

IV. SOILS.

1. *General.*

The Lakes District lies in the western portion of the Fitzgerald region (Teakle 1938) of the zone of grey and brown calcareous solonised soils of Western Australia. This corresponds to the "mallee" zone described by Prescott (1931). Some of the soil types closely resemble those observed at Salmon Gums, while others exhibit properties more characteristic of the main wheat belt, particularly in the Lake Grace and Newdegate districts. These relationships may be due to the underlying geological formations. Apart from the unusually large proportion of the so-called snuffy morrel country, the surface features indicate that the woodland (or forest*) soils and the principal types carrying mallee scrub are suitable for general wheat farming purposes.

In accordance with the nomenclature suggested by Milne (1935), the soils of the district can be grouped as a cantena or sequence of soils ranging from valley types to the sands and gravels of the high level heaths of the peneplain. This sequence is illustrated diagrammatically in Figure 2.

Neglecting the western side of the valley where the slopes rise more or less abruptly from the salinas and where considerable areas of agricultural soils do not

* More appropriately termed "Woodland."

occur, the following groups of soils are encountered as one proceeds eastwards from the eastern edge of the salinas:—

A. *Soils of the valley floor.*

(1) Salt bush heath soils; immature soils on dunes formed from material blown from the salinas.

(2) Snuffy, grey, calcareous woodland soils:—

(a) the Milarup clay loam, characterised by Kondinin blackbutt* and saltbush.

(b) Milarup loam characterised by morrel and boree as principal elements of the vegetation.

(3) Soils of the salmon gum woodlands; soils of the Camm series and the woodland phase of the Pallarup series cover this area. They range from brown to brownish grey sands and sandy loams with a calcareous, sandy clay subsoil.

B. *Soils of the valley slopes.*

(4) The soils of the valley slopes are chiefly grey and brown sandy types with a calcareous, sandy clay subsoil, which carry generally a vegetation chiefly of mallee scrub. Patches of sandy and gravelly heath and strips of woodland occur in this group.

C. *Soils of the peneplain.*

(5) The grey and yellowish sandy and gravelly soils of the peneplain carry either a heath or a wodjil** vegetation association. These soils are azonal—that is, they do not exhibit the characteristics of the woodland and mallee soils regarded as normal for the zone. Prescott (1931) regards them as relics of a period when the climate was much wetter and when a large proportion of the original plant food was lost as a result of a long period of heavy leaching.

Settlement has been largely confined to the woodland and mallee soils as these are of highest fertility and, in consequence, the soil survey was confined largely to these types.

2. *Soil Survey.*

(a) *Preliminary Investigations.*

Before commencing the soil survey, an examination of the soils of the Newdegate district was made to determine the agricultural value of the principal soils of the district. High tribute is paid to the Agricultural Bank inspector of the district, Mr. G. Birt, who assisted in this examination. Mr. Birt made available his valuable practical experience with respect to the important soil types of the district, and gave sound advice concerning reactions under ordinary wheat farming practice. This examination of the Newdegate district, combined with experience in the Salmon Gums district, provided the basis for the interpretation of the results of the soil survey.

(b) *Soil Survey Technique.*

As the result of a preliminary examination of the soils of the Lakes district, a number of soil types were defined on the basis of profile features. Vegetation, salinity and topography were adopted as subsidiary factors in the soil type definitions. In some instances, the degree of salinity was used as the deciding factor between closely related types of the one series.

* Local names are used where possible. A list of corresponding botanical names is given in the appendix.

**Wodjil in this district is a densely growing acacia which may reach a height of 12-20 feet.

Most of the area still being in the virgin state it proved convenient to conduct the survey on the grid system by means of compass traverses, or transects, along which the soil and vegetation changes were noted and mapped, and along which samples for analysis were taken.

Each party engaged on the traverse work consisted of a technical officer, or soil surveyor, and a chainman. Distances were determined by means of a 5-chain steel tape. Roads and block boundaries, which had been recently surveyed, were used as bases for the work, and copies of compilation plans on the scale of 20 chains equals one inch were used for the construction of the soil maps. Generally, the traverses were run at intervals of 17-20 chains and samples were taken every 10 chains, but the soil surveyor was able to use his discretion regarding the location of sites for sampling and other technical matters determinable only in the field. Thus on the average one site represented about 20 acres, so that no more than a general salinity distribution could be expected from the results.

As a general practice the sites were sampled to a depth of two feet and, in order to obtain data regarding the distribution of salt in the profile, samples were taken to represent both the first foot and second foot layers. In order to avoid the difficulty of mixing two layers which were dissimilar both physically and chemically, the sandy surface, where it occurred, was discarded and the top sample obtained from the subsoil above the 12-inch level. It had already been established that the sandy surface was invariably of very low salinity. When the occasion demanded the site would be examined to greater depths.

During the course of the survey, type samples were obtained to represent the chief soils recognised. These were generally taken from a pit dug for the purpose, so that the nature of the profile could be more closely examined than is possible when the soil auger only is used. The locations of sites selected for type samples are shown on Figure 1.

(c) *Laboratory Investigations.*

As the purpose of the survey was the determination of the incidence of salinity, numerous samples were taken to represent the various soil types. These were analysed for salt content in a field laboratory arranged in a canvas tent using the conductimetric method described by Samuel and Teakle (1931). As a check, the chloride titration method of Best (1929) was used on about 25 per cent. of the samples. A further check on the work was obtained from the analyses of the type samples carried out in the Government Chemical Laboratory in Perth.

(d) *Mapping and Interpretation.*

The salinity determinations were recorded in the field books from laboratory sheets and this information, together with that relating to the soil type and other factors, plotted on the base plans. The first factor considered in the classification was the soil type, as it was considered that the properties on which the definition of a soil type was based would determine the agricultural value as well as the subsequent behaviour of the soil after clearing.

Preliminary work indicated that there was a very close correlation between soil type and degree of salinity in the virgin soils. Generally, the more clayey types were more saline, and, on this basis, highly saline, moderately saline and non-saline types within each soil series were recognised. The maps of the southern portion of the area were satisfactorily prepared on this basis. As the survey progressed it became apparent that anomalies occurred under this method and the correlation between soil type and degree of salinity was less satisfactory than originally

thought. Thus the Camm sandy clay loam (1A), a heavy textured salmon gum type, proved generally saline in the early part of the work and in this respect contrasted with the lighter textured Camm sandy loam (1C) which was typically of low salinity. The survey being primarily to determine the incidence of soil salinity, for convenience in mapping the non-saline areas of the Camm sandy clay loam, as indicated by the field analyses, were included in the Camm sandy loam, and vice versa, when the anomalies were relatively infrequent. Later, however, saline and non-saline phases of the Camm sandy clay loam were recognised and mapped as such, thus correcting the errors with respect to soil type boundaries occurring under the original system of mapping. The same difficulty arose with the Milarup loam (4B) and in the later part of the work saline and non-saline phases were recognised. Reference to the field books would enable any necessary adjustments to the soil type boundaries to be made when the information is being prepared as part of the soil survey of Australia.

Three subdivisions with respect to degree of salinity were recognised.

(i) Low salinity.	First foot	— less than 0.10% salt*.
	Second foot	— less than 0.25% salt.
(ii) Medium salinity.	First foot	— 0.10 — 0.15% salt.
	Second foot	— 0.25 — 0.30% salt.
(iii) High salinity.	First foot	— more than 0.15% salt.
	Second foot	— more than 0.30% salt.

These limits were based on experience in the farming areas of Western Australia as well as on information derived from literature, particularly from the United States of America, and are still adopted as satisfactory standards for the judgment of soil salinity with respect to wheat growing in this State. Soils of the high salinity group under normal circumstances may be expected to yield about a half normal crop.

For convenience in presenting the data in map form, low salinity areas were coloured green, medium salinity areas brown, and high salinity areas yellow. Sand heath and wodjil types which were typically non-saline were left uncoloured on the maps. These colours were adopted to avoid confusion with the system of the Department of Lands and Surveys in which blue signifies first class and red second class.

In a recent paper, Teakle and Burvill (1938) have shown that such salinity data must be interpreted on the basis of soil type, and that soil types with a sandy surface which are saline in the virgin state rapidly lose their salinity after clearing. This finding was established as a result of later studies in the Salmon Gums area, and would enable some modification in the interpretation of the analytical data with respect to the Lakes District to be made. However, in the Lakes District there proved to be such a close positive correlation between the heaviness and salinity, and, in the case of morrel soils, between powderiness, or snuffiness, and salinity, that the application of this finding would not materially affect the conclusions with respect to the district.

The areas of each type and salinity grade as mapped on each farm were determined in the draughting room of the Department of Lands and Surveys by means of planimeters and the agricultural possibilities judged from the figures obtained.

* Throughout this paper the term "salt" means sodium chloride (NaCl) as estimated from chloride.

It is hoped that the data may be remapped on a scale of one inch equals one mile to bring this soil survey into line with others in the Commonwealth. At present the only maps available are hand coloured sun prints which are not suitable for publication but serve admirably for advisory and administrative purposes.

3. *Soil Classification.*

Some ten soil series of major importance were recognised in the course of the soil survey and have been named and registered with the International Society of Soil Science. In addition a number of types and variations of minor importance have been described and mapped on the large scale plans.

The soil types described are first listed in groups according to the vegetation association to afford a correlation between this soil survey and the land classification system of the Department of Lands and Surveys which is more familiar to farmers and others interested in agriculture. Following this list there is given a general description of the soil types grouped according to the soil series to which they belong, irrespective of the vegetation association. Brief mention is made of the chief physical and chemical properties which are given in detail in Tables A, B, C and D of the appendix.

In this discussion each soil type is given its series name and class description and, in order to associate these with the nomenclature used in the field survey and in the presentation of the results from the salinity viewpoint, the key numeral and letter, for example 1A, 5A, M8, etc., are also given.

The list of soil types described is as follows:—

(i.) *Soil types regarded as first class in the land classification system of the Department of Lands and Surveys.*

A. Soils of the salmon gum woodland.

(1)	Camm sandy clay loam (1A, 1AC)	13,275 acres.
(2)	Camm sandy loam (1C)	16,389 acres.
(3)	Pallarup sand (5B)	10,408 acres.
(4)	Pallarup sand, deep phase (5A)	1,938 acres.
(5)	Gulson sandy loam (1S)	490 acres.
	Miscellaneous minor types (1B and 1D)	381 acres.
	(8DS)	2,287 acres

B. Soils of the morrell and blackbutt woodlands.*

(6)	Milarup sandy loam (4A)	16,268 acres.
(7)	Milarup loam (4B, 2)	36,630 acres.
(8)	Milarup loam, hardpan phase (4L)	70 acres.
(9)	Milarup clay loam (9)	6,732 acres.

C. Soils of gimlet and merrit thickets.

(10)	Barookee clay (8B)	6,498 acres.
(11)	Varley clay (8D)	6,696 acres.

*In more recent classifications the Department of Lands and Surveys has not included these soil types in the first class group but has mapped them separately as morrel soils.

(ii.) *Soil types regarded as second class in the land classification system of the Department of Lands and Surveys.*

D. Soils of the mallee scrub.

(12)	Pallarup coarse sandy loam (M2, M5)	9,171 acres.
(13)	Pallarup coarse sandy loam, stunted mallee phase (M6)	1,354 acres.
(14)	Pallarup sandy loam, stunted mallee phase (M1)	5,594 acres.
(15)	Pallarup sand (M8)	24,488 acres.
(16)	Baanga sand (M4)	4,218 acres.
(17)	Varley gravelly sandy loam (M3)	1,158 acres.
(18)	Varley clay loam (M10)	165 acres.
(19)	Madden sand (G)	520 acres.
	Miscellaneous types (M7)	63 acres.

(iii.) *Third class soils in the land classification system of the Department of Lands and Surveys.*

E. Soils of the heath and wodjil plains.

(20)	Carmody sand (7)	36,521 acres.

F. Soils of the low-lying areas in depressions and adjacent to salinas which carry mallee and scrub.

(21)	Hurlstone sand (5C)	18,323 acres.

Summarised, the area surveyed may be classified as follows:—

(A)	Salmon gum woodland	45,168 acres.
(B)	Morrel woodland	59,700 acres.
(C)	Gimlet and merrit thickets	13,194 acres.
(D)	Mallee scrub	46,731 acres.
(E)	Heath and wodjil soils	36,521 acres.
(F)	Low-lying soils	18,323 acres.
		219,637 acres.
(G)	Small lakes and rock outcrops	9,030 acres.
	TOTAL ..	228,667 acres.

4. *Description of the Soil Types.*

The principal soils have been grouped into 10 soil series which comprise 20 soil types and phases. In a soil series the profile features, with the exception of the surface layer, are similar with respect to sequence and nature of the layers, and also the nature of the parent material. Thus the sequence of the profile colours as observed on the face of the pit will be substantially the same, as also will be the clayeyness or sandyness of the various layers. Each series is given a name, usually taken from a locality in which it occurs, in order to facilitate its definition. A soil type is a subdivision of a series on the basis of the texture of the surface layer and is designated by the series name and a class name which is the texture of the surface horizon.

In some instances, soil types have been further subdivided into phases on the basis of major variations in vegetation cover and such factors. It might be argued that more series should have been recognised to cover such factors. For instance, it may be reasonable to assume that, in general, the nature of the vegetation association—the growth of salmon gum instead of mallee, or the height and vigour of the mallee scrub—reflects soil characters of considerable agricultural significance but which are difficult, or perhaps impossible, to observe by field inspection of the profile. But this would limit the soil surveyor to complete recognition of soil types only in virgin country, and, further, such an assumption completely overlooks the established fact of succession of vegetation associations and the effect of fires and similar factors on the plant cover.

In addition to the principal types, a number of soils of minor agricultural importance have been grouped as miscellaneous soils and described for the purpose of completeness.

(i) *The Camm Series.*

The Camm series, named after Lake Camm, is the heaviest type of the area associated with the salmon gum woodland. The principal features of the profile are a brown to brownish grey surface of loamy sand or sandy loam not more than 6in. deep, resting on a brown to greenish brown sandy clay subsoil with lime accumulation becoming marked from about 8in. or deeper. With the lime accumulation, whitish and grey colours become important in a mottled subsoil (see Fig. 3).

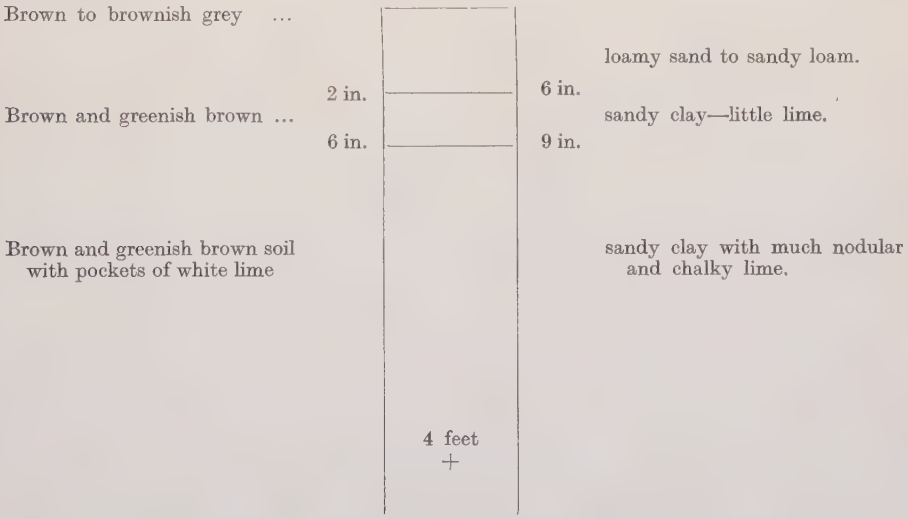

Fig. 3.—Features of the profile of the Camm series.

The series is probably developed on granitic or gneissic rock material.

Proceeding from south to north, there is a gradual change in the colour of the soil; grey shades are more obvious in the south and the browns in the north.

The vegetation association may be described as a sclerophyll woodland in which salmon gum, gimlet, boree and mallee scrub are the chief of the larger plants. Other species are merrit, hop, daisy, centipede bush, clay bush, quondong, *Eremophila pachyphylla, E. glabra,* rushes, *Danthonia, etc.*

Chemically, the soils of this series are low in phosphate but are rich in lime, potash and magnesia.

For general agricultural purposes this series is undoubtedly the best of the district. Unfortunately, however, the heavier type is often saline but observations at Salmon Gums indicate that it may improve under appropriate management for pasture production and grazing.

The series is divided into two types on the basis of the depth of the surface sandy loam horizon.

Camm sandy clay loam (1A, 1AC).

In the Camm sandy clay loam the A horizon is limited to 2 - 3in. of sandy loam and rests on a sandy clay subsoil in which the lime accumulation commences at a depth of 6 - 9in. It is designated a sandy clay loam as, when ploughed, the admixture of the clay subsoil with the sandy loam surface will give rise to a soil which will behave agriculturally as a heavy type. The soil is commonly characterised by gilgai or crabholes. These are undesirable agriculturally as they interfere somewhat with cultivation. Furthermore, the heaviness of the soil is undesirable under low rainfall conditions and crops will be subject to drought effects when the rainfall is below average. Associated with the heaviness is a concentration of soluble salts in the profile to an undesirable degree. Analyses of samples from 717 sites averaged 0.18% salt in the first foot and 0.35% salt in the second foot. This concentration of soluble salts will increase the liability of crops to suffer during drought periods and would lower substantially the general crop yields of sensitive crops such as wheat. The type should be very well suited for Wimmera rye grass establishment which will be a valuable basis for stock raising as an adjunct to wheat growing.

Camm sandy loam. (1C.)

The surface or A horizon of the Camm sandy loam consists of from three to six inches of sandy loam. Crabhole development is uncommon, but in other features the type closely resembles the sandy clay loam. The vegetation is also very similar but includes such plants as rosemary and *Restionaceae* which are indicative of more sandy conditions. Salinity is typically low in this type. Samples from 817 types averaged first foot 0.06% salt, second foot 0.17% salt.

It is considered that this type is the most suitable in the district for general agricultural purposes.

(ii) *The Gulson Series.*

Gulson sandy loam. (1S).

Only one soil type was recognised in this series and has been described as the Gulson sandy loam. The profile consists of a red brown sandy loam surface, somewhat powdery in nature to a depth of about one foot, on a brown light clay with small calcareous nodules. Below two feet the colour lightens to light brown, and both chalky and nodular limestone have accumulated. (See Fig 4).

The vegetation cover is an open woodland of salmon gum with an undergrowth chiefly of salt bush with scattered daisy, quondong and clay bush. Analysis of 28 sites representing this site showed it to be generally non-saline. It should be quite suitable for general agricultural purposes.

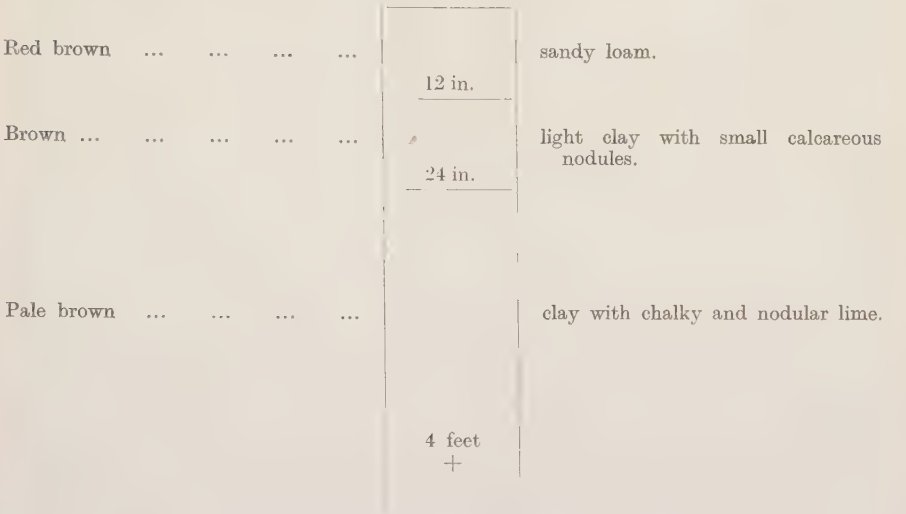

Fig. 4.—Features of the profile of the Gulson series.

(iii.) *The Milarup Series.*

A range of grey brown to dark brownish grey highly calcareous soils of loose, powdery structure when dry, and which are typically associated with a morrel and boree woodland, is included in the Milarup series. The surface layer of the soil is darkened by humus enrichment and is rich in calcium carbonate. In this latter respect it varies from the usual normal soils of the zone as the calcium carbonate is characteristically confined to the subsoil or B horizon. Frequently the surface quarter of an inch has a somewhat platy or crusty structure due, apparently, to the growth of small organisms in a rich soil medium. Representative profile features are illustrated in figure 5.

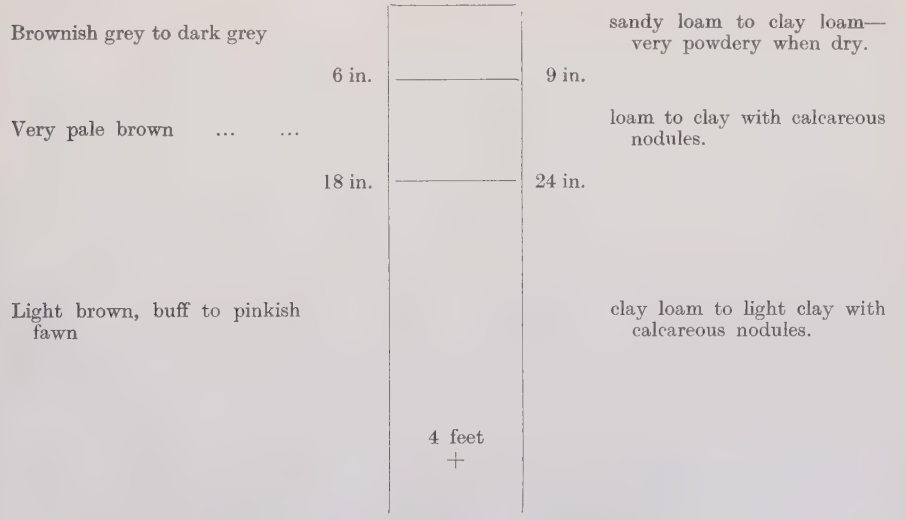
Brownish grey to dark grey
sandy loam to clay loam—very powdery when dry.
6 in.
9 in.
Very pale brown ... ...
loam to clay with calcareous nodules.
18 in.
24 in.
Light brown, buff to pinkish fawn
clay loam to light clay with calcareous nodules.
4 feet
+

Fig. 5.—Features of the profile of the Milarup series.

The surface is brownish grey to dark grey in colour and ranges in texture from sandy loam to soft clay loam. It is commonly from 6-9 inches deep and in the virgin woodland is usually bounded by a mass of roots and rootlets. The powdery condition when dry is one of the most important features and appears to render it unsatisfactory for ordinary cereal crops until thorough compaction occurs. Whether the content of calcium carbonate is responsible for this powdery condition has not yet been determined. Below the surface horizon is an intermediate layer of light brown to very pale brown soft clay loam rich in lime in the fine earth, and often with a few calcareous nodules. Below this again is a highly calcareous subsoil which ranges from clay loam to soft clay in texture, and in colour from light brown, grey brown, and buff to pinkish fawn. This subsoil is typically rich in limestone nodules, usually loosely embedded in a loose soil mass. In some instances the limestone nodules may be cemented to form a dense hardpan. With depth, clay accumulation occurs and the subsoil becomes more compacted, particularly in the heavier types.

The series carries a characteristic vegetation association. The chief elements are red and black morrel, forbor, boree and merrit. Kondinin blackbutt is characteristic of the heavier textured types near the lakes. Of the undergrowth the commonest species are navy bush, daisy, hop, salt bushes, *Kochia spp.*, *Eremophila glabra* and *E. pachyphylla*.

Chemically the soils of the Milarup series are the richest in plant mineral requirements. While the phosphate is low, it is somewhat higher than in the other soil series and, in addition, shows a substantial accumulation in the surface or A horizon. It is rich in potash throughout the profile, most of the samples containing more than 1% potash (K_2O). The soil is particularly rich in lime; even the surface horizon generally contains from 5-10% calcium carbonate, while the subsoil may contain up to 40% calcium carbonate in the fine earth fraction. In addition to this, there is a considerabe amount of lime in the form of calcareous nodules which are not included in the analyses reported in Table C of the appendix.

With the exception of the Milarup sandy loam, the soils of this series are generally unsatisfactory for wheat growing, except in years of generous rainfall. When the rainfall is adequate apparently the wheat crop is able to take advantage of the generous supply of plant mineral requirements, but, apparently due to the physical condition, crop growth suffers during the spring months in dry seasons. The soils of the series generally have a value for pasture production, and barley grass, Wimmera rye grass and salt bushes are the most promising species. Liability to salt accumulation, particularly in certain types, further limits the value for agricultural purposes.

The series has been sub-divided into three types and one phase.

Milarup sandy loam. (4A).

The profile characteristics of this type are a brown to grey sandy loam surface, generally calcareous and somewhat powdery when dry, and a clay or sandy clay subsoil which is usually firmer than in the case of the more typical Milarup loam.

The type is frequently transitional between the Milarup loam and types of the salmon gum woodland, and is very variable on that account. In some cases areas which include a pattern both of the salmon gum woodland types and the Milarup series have been mapped as the Milarup sandy loam.

Generally, the type is relatively low in salinity; samples from 919 sites averaged 0.05% salt in the first foot and 0.14% salt in the second foot. Agriculturally the type is reasonably suitable for general farming, including both wheat and pasture production.

Milarup loam. (4B, 4BA, 2).

Of all the so-called snuffy morrel soils recognised by agriculturists in Western Australia, the Milarup loam is probably the most snuffy or floury. When dry, the surface material will frequently flow like silt, will not readily absorb water, and will take an impress in considerable detail; for instance, the finger prints and lining on the hand can be clearly impressed on a pile of the fine, dry surface soil. Naturally a soil of this nature is difficult to compact should it be ploughed deeply in the course of cultivation, and is very liable to wind erosion under fallow conditions. Experience shows this snuffy condition to be undesirable agriculturally as satisfactory wheat crops are unusual except in wet seasons.

The surface soil is highly calcareous but the percentage of calcium carbonate in the profile increases with depth showing accumulation in the subsoil or B horizon. In the subsoil the calcium carbonate occurs both as nodules and in a floury or marly condition in the fine earth fraction. In some instances the calcareous nodules comprise as much as 50 per cent. of the soil mass.

Although the Milarup loam is the richest soil of the district from the chemical viewpoint, in the early years of development the type will be more suited to pasture production than to wheat growing. When cultivated, only a shallow surface working should be used and the use of stock and compacting implements is advised to bring about an improvement in the structure of the soil. In the course of years these methods bring the soil to a more satisfactory condition and the type will produce fairly satisfactory crops when the season is suitable. However, the type must be regarded as one of the most difficult of all the eucalyptus woodland soils to manage for arable agriculture.

Coupled with these disabilities is a high liability to salinity. The structure of the soil appears to limit moisture penetration and favours capillary rise even when only in the moist state, and no water table is within many feet of the surface. In consequence, under cultivation, the Milarup loam is very commonly affected by infertile salt encrusted patches (see Teakle and Burvill (1938) pp. 224-225), which seriously reduce productivity. The average salinity of samples from 1,739 sites, principally in virgin country, was: first foot 0.19% salt, second foot 0.37% salt.

The principal elements of the vegetation have been listed above. A characteristic species which warrants further mention is a type of boree which has been designated forbor (*Melaleuca quadrifaria*). This has been found to be a useful indicator of salinity and an undesirable snuffy condition.

Milarup loam-hardpan phase (4L).

This phase is characterised by a hardpan or cement of travertine (calcium carbonate) which occurs at a depth of about one foot. It is characteristically low in salinity. However, it is of low agricultural value on account of the snuffy condition of the surface when dry and the shallow depth of the useful soil.

Milarup clay loam. (9).

The Milarup clay loam exhibits many of the general features of the loam type described above but is less snuffy and somewhat heavier throughout the profile. It generally occurs in closer proximity to the salt lakes and is characterised by a rather open stand of Kondinin blackbutt, a thick ground cover of salt bush and scattered clumps of forbor. Box thorn and grey bush are common species of minor intensity.

The profile typically consists of about six inches of heavy loam or clay loam, dark grey in colour, with a subsoil of brownish grey to grey brown clay loam or light clay to a depth of three feet. Below this depth the subsoil is browner in colour and more clayey in texture, but a dense clay is not encountered until a depth of several feet is reached. The profile is calcareous from the surface to a depth of nine to ten feet, but calcareous nodules are far less common in the subsoil than in other types of the series. There is evidence that the profile is acidic and non-calcareous below ten feet.

The soil is generally highly saline. Samples from 302 sites, largely in virgin country, averaged: first foot 0.30% salt and second foot 0.59% salt. The type is of low value for cropping purposes where saline but has a value for stock raising on account of the salt bush. It will probably carry a variety of grasses when partly cleared and fertilised. As is the case with other types of the series, the fertility status with respect to plant mineral requirements, except phosphate, is good, and with judicious grazing the type should be of considerable value for stock raising.

(iv.) *The Varley Series.*

Strips and patches of heavy soils, reddish to brown in colour, occur on the rising ground intermixed with the lighter soil types. These appear to be formed on rock exposures probably of different mineral composition from the main mass of the country rock, and, from the point of view of vegetation cover, are characterised by gimlet, frequently in the form of whipstick thickets. The series should be quite good agriculturally but on account of the heavy texture will probably suffer from drought in low rainfall seasons. Three types have been recognised:—

Varley Clay (8D).

The profile is relatively simple and typically shows a surface layer of red brown clay to a depth of about one foot, with a subsoil of light brown calcareous clay. The surface is frequently strewn with quartz and ferruginous gravel and generally breaks into cracks during the dry summer period. Crabholes sometimes occur.

Whipstick gimlet is the typical vegetation and associated with it are merrit, hop, and a variety of teatrees, including umbrella bush. Curiously enough, in spite of the heavy texture, this soil is characteristically non-saline. The average salt content from 438 sites was: first foot 0.06% salt, and second foot 0.16% salt.

Varley Gravelly Sandy Loam (M3).

Included in the Varley series is a small area, 1,158 acres, of stunted mallee country which occurs as strips between the sandplain and the timber country. The profile consists of a few inches of brown to red brown gravelly sandy loam on a

brown subsoil in which the clay content increases until a heavy clay horizon is encountered in the second foot. This clay subsoil is frequently mottled with red patches, apparently of decomposing laterite.

The chief species associated include a number of mallees, a sprinkling of gimlet, native cherry, and a variety of teatrees. In the virgin state the soil is typically saline, samples from 61 sites averaging 0.23% salt in the first foot and 0.41% salt in the second foot.

Varley Clay Loam (M10).

A small area of soil in which the profile consists of a red clay loam on a red clay subsoil has been included in the Varley series on account of the similar profile features. The vegetation is principally stunted mallee scrub which may represent a succession from some more robust vegetation in previous years. It resembles the Varley clay in being relatively low in salinity. Samples from five sites representing the type averaged 0.11% salt in the first foot and 0.26% salt in the second foot.

(v.) *The Barookee Series.*

Barookee Clay (8B).

A soil type, related closely in many ways to the Varley clay, but differing in colour, structure, and vegetation association, has been named the Barookee clay. Like the Varley clay, this type occurs generally in strips in lighter country and probably is the result of exposure of different rock types. The surface horizon consists of about nine inches of heavy clay loam or light clay, which is somewhat powdery when dry and brown to light brown in colour. The upper subsoil to a depth of about three feet is a pale brown, highly calcareous clay, the calcium carbonate being generally of a chalky nature. A little mottling of red iron stains sometimes occurs. Below three feet is a somewhat uniform brown clay, relatively low in lime.

The vegetation is typically a thick growth of merrit often associated with a little gimlet and occasional salmon gum. A dense undergrowth largely of umbrella bush, *Acacia spp.*, needle bush, with some native cherry, boronia and hop is characteristic.

Unlike the Varley clay this type is highly saline. Three hundred and seventy-eight sites representing the series gave an average salinity of 0.22% salt in the surface foot and 0.42% salt in the second. On account of the salinity it is unlikely that this type will be of much value for wheat-growing, but where it has been cleared in association with other more satisfactory types, it will probably have some value, particularly for pastures. While the type is rich in potash, it is particularly low in phosphate so that little growth of valuable pastures can be expected without the use of superphosphate. The high sodium content of the replaceable metallic cation fraction in the surface soil is another undesirable feature. (Table D of the appendix.)

(vi.) *The Pallarup Series.*

In this series has been placed a number of soil types which, while undoubtedly closely related, may, on closer examination, be classified in different series. In the absence of this necessary information it has been deemed advisable to associate these related types on the understanding that sub-division into additional series may be advisable in the future. For the present the relationship of these

types is emphasised, but the descriptions include all of the information at present available regarding each soil type or phase, and each can well be considered as a unit. Thus from the agricultural viewpoint it may be desirable to consider the timber phase of the Pallarup sand (5B) as distinct from the mallee scrub phase (M8), but definition as separate series is undesirable in view of the inadequacy of the field and laboratory data at present available.

The essential features of the Pallarup series are a surface sandy layer which ranges in depth from two to three inches in the case of the heavier types to as much as two feet in some of the more sandy types, and a subsoil of sandy clay loam to sandy clay. Cementation of the surface of the subsoil results in a sharp break between the sandy "A" horizon and the clayey "B" horizon. The surface colours range from brown to brownish greys on the surface and, where the sand is deep, these shade off to pale brown, grey or even white in the subsurface. In the subsoil the predominant colours are greenish browns and greenish greys. Calcium carbonate, partly in the form of hard nodules, accumulates in the subsoil. The commencing depths for calcium carbonate accumulation range from about eight to 20 inches, depending on the thickness of the surface sand. The upper part of the subsoil (B_1 horizon) is typically only very slightly calcareous. (See Fig. 6.)

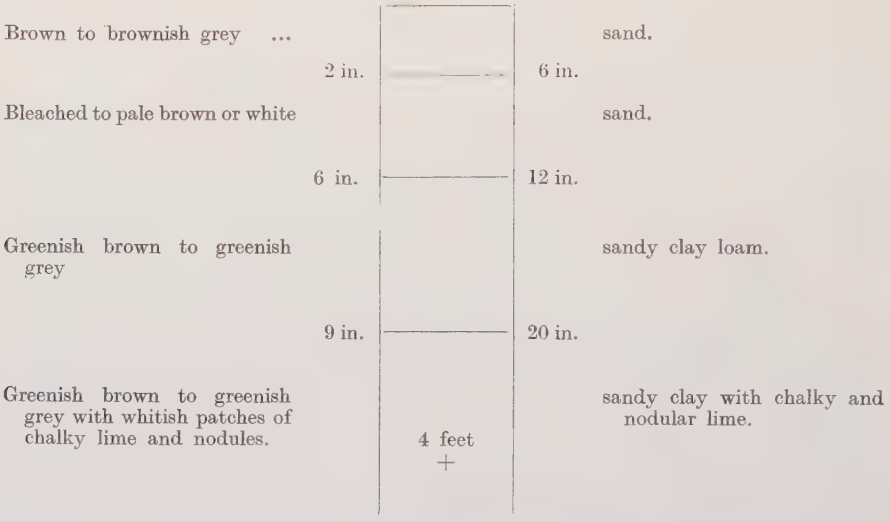

Fig. 6.—Features of the profile of the Pallarup series.

According to the feel in the field, the surface sand varies from relatively fine to relatively coarse. From the absence of confirmatory data from the results of mechanical analyses it seems probable that this variation is due to differences in grain size distribution within the coarse sand fraction (0.2 to 2.0 mm. diameter). No sieving data are available. This variation, as recognised in the field, has been used to separate soil types in mapping, as it is suspected that this property of the sand fraction is indicative of more fundamental variations in the parent material. Further information is required to establish this point but is not obtainable under present conditions.

The soils of the series are very low in phosphate, potash is relatively low in the surface but generally exceeds 1% in the subsoil. With the use of superphosphate the fertility status of this soil should be readily maintained, and, as the

lightness of the surface layer promotes water absorption and moisture retention, these types, where the depth of the sand is not excessive, are of considerable value for agriculture under low rainfall conditions. Under fallow conditions the soil is liable to wind erosion, which would seriously reduce the agricultural value if the surface were completely removed and the subsoil exposed. The chemical properties of the subsoil clay render it undesirable for cultivation so that every effort should be made to preserve the natural surface to maintain the cropping value of the soils.

The vegetation is typically a mallee scrub, generally more or less stunted, with an undergrowth of needle bush, blue tea-tree, rosemary, *Hibbertia sp., Restionaceae,* etc. Areas of similar profile characteristics which carry salmon gum have been recognised as a phase.

The Pallarup series of the Lakes District and the Circle Valley series of the Salmon Gums district are very similar in general properties. They undoubtedly belong to the same fasc or group of soil types, but sufficient work has not yet been done to decide their precise relationships and for that reason they are described as different series. It is known that they are very closely related chemically, but further work with respect to other properties would be needed before the soils were included in the one soil series.

Pallarup Sandy Loam (M1).

The profile consists of 2 to 3 inches of light brown sand on a greenish brown to greenish yellow sandy clay loam subsoil. Below about 9 inches calcium carbonate, largely as rubble, accumulates and a calcareous clay subsoil extends to a depth of several feet.

An open, low mallee scrub, 6 to 8 feet high, is the characteristic vegetation; low tea-trees, *Acacia spp.,* needle bush, boronia, daisy, etc., comprise the undergrowth.

In the virgin state, the soil is frequently moderately saline, the average of all samples representing the type being 0.12% salt in the first foot and 0.30% salt in the second foot. Following clearing a certain amount of leaching should occur, with the result that salinity should not materially affect crop growth in this soil type.

Pallarup Coarse Sandy Loam (M2 and M5).

The profile consists of 2 to 3 inches of light brown coarse sand on a yellow brown sandy clay loam to sandy clay subsoil in which limestone rubble accumulation commences at about 9 inches. The vegetation is a well grown mallee scrub, 12 to 15 feet in height, which, together with the coarseness of the sandy surface, differentiates it from the Pallarup sandy loam described above. The ground cover consists largely of tea-trees and shrubs.

The soil survey showed that, while the salinity is generally high in the southern areas, a considerable proportion of the type is relatively low in salt in the northern part of the district. The more saline phase has been mapped as M5 on the working plans and the non-saline phase as M2. Analyses of samples representing these phases are as follow:

Depth (feet)	M5 (saline phase) 265 sites.	M2 (non-saline phase) 214 sites.
First foot	0.21% salt	0.05% salt
Second foot	0.39% salt	0.15% salt

From subsequent experience in the Salmon Gums district it appears that the occurrence of salt in the Pallarup coarse sandy loam should not seriously interfere in crop returns, on account of the degree of improvement after clearing, but some reduction in yield must be expected on this account. The soil type can be regarded as good class mallee land where the salinity status is low in the virgin state, and can be given a fairly satisfactory rating even where the salinity in the virgin state proved high.

Pallarup Gravelly Sand (*M6*).

The Pallarup gravelly sand is a type largely confined to the southern portion of the area where higher rainfall occurs and some degree of impeded drainage in the winter appears to be a factor in its development. The profile consists of a few inches of light brown to grey brown coarse sand with some ferruginous gravel on a brown sandy clay subsoil. In the second foot the subsoil is a greenish brown sandy clay with limestone rubble.

The vegetation is characteristic and consists largely of stunted mallees, chiefly swamp gimlet, stunted blue teatree and umbrella bush, and a variety of shrubs.

The type proved highly saline, samples from 58 sites averaging 0.25% salt in the first foot and 0.49% salt in the second foot. On account of the nature of the profile and the salinity, it is likely to be of inferior agricultural value.

Pallarup Sand.

A number of mallee and timber phases in which the profile characters are essentially similar have been included in the Pallarup sand. Further information may enable separation to be made of some of these phases into distinct series. It is the most extensive mallee scrub type of the district, and important areas of salmon gum woodland have been mapped as a woodland phase of the type.

The surface or "A" horizon consists of from six to 12 inches of sand, relatively fine to the feel, and grey brown to brownish grey in colour on the surface. The lower part of the sand layer is typically bleached and in the lighter mallee scrub types is reduced to a white colour. The subsoil is a greenish brown to greenish grey calcareous sandy clay loam or sandy clay with much calcareous rubble below about 15 to 20 inches. When dry, the subsoil cements to a very hard layer, particularly at the surface of the clay in contact with the sandy surface ("A" horizon).

Pallarup Sand-mallee Scrub Phase (M8).

The vegetation is principally mallee scrub of medium height (10 to 12 feet) with blue teatree associated with other shrubs as the principal undergrowth. The salinity is generally low in the virgin state and, on account of the rapid leaching of salt after clearing, soil salinity will not be an agricultural problem on this type. The type is of only medium fertility on account of the depth of the surface sand, but should be satisfactory for general agriculture, particularly in low rainfall areas. Special attention should be given to the control of wind erosion in the management programme.

Pallarup Sand-woodland Phase (5B).

Where salmon gum woodland occurs on the Pallarup sand the soil is generally browner in colour, and the high degree of bleaching common in the subsurface layer of the mallee scrub phase is typically absent. It is probably of somewhat higher fertility status, although the profile features are essentially the same.

On this phase the vegetation includes salmon gum, redwood, yorrel, a variety of mallees and an undergrowth principally of daisy, rosemary and *Restionaceae*. The significance of the difference in vegetation cover is not understood.

The salinity is typically low, samples from 460 sites averaging only 0.05% salt in the first foot and 0.14% salt in the second foot. The phase is regarded as of very considerable agricultural value, but like the mallee phase, it should be carefully managed on account of liability to wind erosion.

Included with this phase of the Pallarup sand is a sub-type, mapped as 5A in the field, in which the surface sand is from one to several feet deep, but in which the subsoil appears to be more or less typical. This sub-type covers only a small area (1,938 acres) and is largely confined to large dune-like rises on the east side of the salt lakes. Sand salmon gum commonly replaces salmon gum, but the vegetation is otherwise similar. More psamophilous shrubs are common.

(vii.) *Baanga Sand* (M4).

A low fertility sandy soil in which the profile consists of at least a foot of grey brown to light brown sand on a reddish brown sandy clay subsoil with some calcareous rubble. In the virgin state vegetation is principally stunted mallees and low broom bush, with a variety of *Restionaceae* and small shrubs on the undergrowth. It is a low fertility type, generally occurring adjacent to the Carmody series with which it has probable relationships. It is typically non-saline.

(viii.) *The Carmody Series.*

Included in the Carmody series is a group of sandy and gravelly (ferruginous) soils of the heath plains commonly known as sandplain. Common profile features are a surface of about six inches of brownish grey sand, often with a yellowish tinge, on a brownish yellow loamy sand subsoil with loose ferruginous gravel. The gravel typically increases with depth to reach approximately one half of the soil mass. Below the loose gravel and sand layers is a cemented whitish sandy material with some decomposing ferruginous inclusions.

The soils of the heath plains range from deep sands to highly gravelly types. They are of low fertility, rather acidic in reaction, and calcium carbonate does not appear to accumulate, even in the deeper parts of the subsoil. They are low in all of the usual plant mineral requirements. However, where a certain amount of clay accumulation occurs in the subsoil, these types may be useful agricultural soils and, with generous use of superphosphate, generally yield satisfactory cereal crops in the years of lower rainfall.

In the southern portion of the area, strips of brown clayey soil occur in the sandy heath types. The subsoil is calcareous and the profile resembles types of the mallee scrub rather than of the heath vegetation associations. However, the natural vegetation is limited to sparse low shrubs and scattered stunted mallees. This type was not mapped but included in the areas classified as the Carmody series.

(ix) *Hurlstone Sand* (5C).

This type embraces the sandy surfaced soils of depressions and low lying areas adjacent to the salt lakes.

Throughout the area, particularly in the vicinity of the salt lakes in sandy formations, are patches of sandy surfaced soils which resemble the Pallarup sand in general profile features. These soils have developed in low-lying areas and

depressions and carry a vegetation association which is commonly described as lakey, as indicative of lakey conditions and the probable proximity of a salt water table.

Typical species include swamp gimlet, *Eucalyptus annulata,* yorrel, odd Kondinin blackbutt, *Melaleuca thuyoides,* borees, paper bark, teatrees, etc.

As in the profile of the Pallarup sand, the surface of the Hurlstone sand consists of from six inches to one foot of sand which is grey brown to light brown in colour on the surface and whitish in the subsurface layers. The subsoil is a brownish to greenish sandy clay. Lime accumulation occurs with depth, and from 18 to 20 inches calcareous rubble embedded in the clay is common. An interesting feature is the green colour which is apparent in newly exposed subsoils throughout this type. This seems to be due to reducing action following waterlogging of the surface sand during periods of wet weather.

The Hurlstone sand is very variable in salinity. The average for 409 sites gave a concentration of 0.14 per cent. salt in the first foot and 0.30 per cent salt in the second foot. This would place the type in the medium salinity group, but in mapping it has been regarded as potentially saline, because experience in other districts shows that a high degree of salinity is liable to develop due to a rise in the salt water table in the course of a period of years. Development of the surrounding country leads to a general rise in the water table and this has the effect of raising the salt water table in the low-lying areas to such an extent that surface evaporation becomes possible and salt accumulation is observed on the surface of the soil, rendering the land virtually useless for agriculture. In the initial stages of development, salinity does not show on this soil type and the immediate result of clearing would be a leaching of the salt into the deeper layers of the subsoil as in the Pallarup sand and related types. It was felt, however, that this type should be mapped as one potentially liable to serious damage from salinity, so that farmers would be warned as to possible future developments.

(x) *Madden Sand* (G).

Around the granite outcrops occur shallow brown sandy and sandy loam soils apparently formed from the granite rock material which occurs a foot or so below the surface. These soils in the virgin state carry a vegetation principally of York gum mallee and jam, with a variety of shrubs, of which a type of hop (*Dodonea larraeoides*) is typical.

(xi) *Miscellaneaus Soil Types.*

Sub-type 1*B.*

Heavy gimlet flats where the soil consists of a few inches of brown loam on a light brown heavy clay subsoil were classified as sub-type 1B. This soil appears to be of reasonable fertility, but is low-lying, liable to inundation and is not regarded as of high agricultural value. It is of little importance as it covers an area of only 347 acres in the district surveyed.

Sub-type 1*D.*

A soil type of low-lying areas which carries some gimlet and scattered salmon gum. The profile consists of a shallow surface of grey gritty sandy loam on a greenish brown sandy clay subsoil. It is highly saline and is regarded as of little agricultural value.

Sub-type 8DS.

A range of apparently related soil types, characterised by a brown sandy clay loam surface and a variable subsoil, has been mapped as 8DS. It appears to be related to the Varley clay in many respects and is apparently formed where basic rocks occur in relatively large patches, commonly where the topography is distinctly hilly. The chief profile features are a brown to red brown sandy clay loam surface, with a certain amount of ferruginous and other gravel, resting on a brown sandy clay subsoil, usually rich in calcareous rubble. In some instances, soils with a pale brownish green subsoil, rich in calcareous rubble, have been included in the type.

The typical vegetation is a woodland of salmon gum and gimlet with a variety of shrubs comprising the ground cover. The salinity is low, the average from 124 sites being 0.06% salt in the first foot and 0.17% salt in the second foot. The type should be of good agricultural value.

Sub-type M7.

Small patches of soil resembling the Milarup series in certain profile features, but which carry a stunted vegetation of mallee scrub, have been mapped as sub-type M7. These patches are of very little agricultural significance.

V.—DISCUSSION.

The soils of the Lakes District may be discussed under four headings:

1. The general fertility status.
2. Chemical and physical properties.
3. The salinity problem.
4. Agriculture.

1.—*General Fertility Status.*

In accordance with the policy of the Department of Lands and Surveys with respect to land classification, lands of the agricultural areas to the extent of 53,000,000 acres have been grouped into first, second and third classes. These classes are essentially indices of estimated land values for agricultural purposes, and have proved to be extremely useful in land settlement. In the wheatbelt, these classes correspond very closely to the main vegetation types.

The first class land typically carries woodlands of salmon gum, York gum, gimlet, morrel, etc. The second class land typically carries mallee scrub, scrubby jam, etc., and the third class lands are the heath and wodjil plains where the soils are sandy or gravelly in character.

Experience has shown that the vegetation cover is a reasonably reliable guide to the productive capacity of the soil. However, as land settlement extended to the lower rainfall areas such as Lake Brown, Salmon Gums and the Lakes District, serious anomalies were experienced in the application of this method of classification. The snuffy soils of the morrel woodlands proved unsatisfactory for wheat growing, particularly in Lake Brown and other areas in the Merredin and Fitzgerald regions (Teakle, 1938). Soil salinity interfered somewhat at Lake Brown and to a considerable degree at Salmon Gums. In the Lakes District, snuffy soils of the morrel woodland and saline soils combined to render the old method of classification difficult to apply. In this survey the anomalies have been substantially corrected by recognition and mapping of the principal causative factors, and it has been established that, apart from the incidence of anomalies due

to the characters of the morrel woodland soils and salinity, it can be assumed that generally the woodland types are of first class grade and are of normal productive capacity. Soil types of the mallee scrub are intermediate and the sand heath and wodjil types are of least productive capacity.

Of course, the better class mallee scrub soils such as the Pallarup coarse sandy loam, may be superior to the inferior woodland types and good class heath land may be quite productive in suitable seasons, but the generalisation holds and the success of the district will largely depend on the utilisation of the suitable woodland and better class mallee scrub soils. Deeper sandy types, while reasonably productive if suitably managed, have not the mineral resources in the surface layers and will be liable to erosion and impoverishment if over-stocked.

2.—Chemical and Physical Properties.

Chemically, the woodland and better class mallee scrub soils of the Lakes District are as sound with respect to the main mineral requirements for plant growth as in any part of the same soil zone in Australia. There is no doubt that the feeding quality of the pasture produced is high and, apart from areas affected by excessive salinity and the difficulties associated with the snuffy morrel group, the cropping capacity of these soils should be satisfactory. Excepting the Carmody series, which is representative of the heath and wodjil plains, examination of the analytical results (see Appendix A) shows that for the soils of the district the lime, magnesia and potash status is very high, particularly in the subsoil, and these qualities probably reflect an abundance of many other important soil minerals. Phosphate is deplorably low. The soils of the Milarup series, in which some surface accumulation of phosphate has occurred, suffer from other disabilities. Fortunately, phosphate can be cheaply supplied as superphosphate and effectively overcomes the deficiency. The reaction of these soils is typically alkaline, particularly in the subsoil, but is not excessively so.

In common with all dry land soils, total nitrogen and organic matter are low but apparently adequate for ordinary farm practice under wheatbelt conditions. In comparison with soils of more developed areas where the carbon : nitrogen ratio tends to approach 10, for these soils the ratio is fairly wide, particularly in the surface. In this property these soils are related to those of the "mallee" areas of South Australia (Prescott and Piper, 1932). Furthermore, the ratio is wider in the surface layers than in the subsoil and is wider in the case of the light Pallarup soils than in the Camm and Milarup types. These facts indicate that the carbonaceous fraction of the leaves, bark, etc., added annually is not decomposed with sufficient rapidity, in comparison with the loss of the nitrogenous fraction, for the formation of soil organic matter with a carbon : nitrogen ratio approaching 10. While this is probably largely the result of climatic conditions, the wider ratio of the Pallarup series, as compared with the Camm and Milarup series, indicates that the mineral status of the soils is also of importance.

Of considerable interest is the composition of the replaceable cations, those labile minerals of the clay and organic matter. In alkaline soils, the chief constituents of this fraction are calcium, magnesium, potassium and sodium, and a knowledge of the ratio of these minerals gives an important clue to the history and nature of the soil and indicates probable reactions under farming practice. This information also assists in grouping the soils into zones recognised elsewhere.

In general, the composition of the replaceable cation fraction of the soils of the Lakes District compares closely with that of South Australian soils of the mallee zone described by Prescott and Piper (1932). The surface or "A" horizon

is of normal composition, the dominant replaceable cation being calcium, but sodium is higher than for soils regarded as normal according to European and American standards. In the subsoil, the calcium of the fraction is largely replaced by sodium, the degree of replacement increasing with depth in the profile. This process of replacement of calcium by sodium is known as solonisation, and it is thought that, in this instance, it is due to age-long treatment with rain water which, in this district, carries down from 20 to 30 lbs. of sea salt per acre per annum. Under these low rainfall conditions a very large proportion of the moisture absorbed from the rainfall is dissipated by the vegetation, the salt accumulates in the subsoil and, in consequence, the sodium enters the soil as a replaceable cation. Calcium accumulates largely in the form of calcium carbonate.

The high calcium status of the surface layers is evidently due to the leaching effect of the rain water in the immediate surface layer or zone of leaching. Laboratory studies carried out by Kelley (1937) in California have demonstrated that leaching with pure water will bring about this accumulation of replaceable calcium even on soils originally rich in sodium.

In common with soils throughout Australia magnesium constitutes a large proportion of the replaceable metallic cation fraction. As replaceable magnesium is high in soils under a wide variety of conditions, it is thought that the process of solonisation has probably not contributed to the magnesium concentration in this instance.

It has been well established that soils of most desirable physical properties and most suitable for agricultural development are those in which calcium is high in the replaceable cation fraction. For this reason it is unfortunate that the surface layers of these soils are of the calcium-magnesium type. But the subsoils are of the sodium-magnesium type with respect to replaceable cations. Sodium clays usually exhibit undesirable physical properties. They readily lose their structure. They are sticky when wet and readily puddle when cultivated so that they come intractable to work with agricultural implements. For this reason it is imperative that the surface soils in the Lakes district be protected as far as possible against loss. Erosive forces must be strictly controlled and cultivation should not be so deep that the subsoil clays, rich in sodium and with undesirable physical properties, are brought to the surface. Subsoil farming on these soils will be difficult and unprofitable, not only on account of the undesirable physical qualities under cultivation, but also because such soils provide an unsuitable medium for the proper development of crop roots.

Another point of interest with respect to the chemical nature of these soils is the concentration of calcium carbonate in the surface of the Milarup and Barookee series. Normally, as in the Camm and Pallarup soil series, calcium carbonate accumulates in the clay subsoil in what is technically known as the B_2 horizon. In the Milarup and Barookee series, however, the surface layer contains several per cent. of calcium carbonate. It is thought that the presence of calcium carbonate in the surface layers is due to the cycle of minerals brought about by the action of the vegetation. From field observations it is thought that the vegetation associations occurring on these soil types deposit calcium in their leaves, bark and other debris faster than it is removed by the leaching action of the rain. Consequently, the surface, as well as the subsoil, is calcareous. In the other soil types, under a different vegetation association, the deposition of calcium is at a slower rate than the loss from the surface as a result of leaching by the rain water, so that accumulation is confined to the subsoil.

Details of the chemical data are given in the tables A, B, C, and D in the appendix. These are summarised in Table 2.

TABLE 2.

Distribution Table showing Mineral Status of the Woodland and Mallee Scrub Soils of the Lakes District. The numbers show the Percentage in each range of the number of samples examined.

PHOSPHATE (P_2O_5) PER CENT.

Range	Below ·005.	·005–·01.	·01–·02.	·02–·04	·04–·06.	·06–·08.	·08–·10.	No. of Samples Examined.
Surface	9	27	41	18	5	....	....	22
Subsoil	19	33	38	5	5	....	....	21

POTASH (K_2O) PER CENT.

Range	Below ·10.	·10–·20.	·20–·30.	·30–·50.	·5–1·0.	1·0–1·5.	1·5 and above.	No. of Samples Examined.
Surface	9	14	13	23	9	23	9	22
Subsoil	....	....	....	5	30	40	25	20

LIME (CaO) PER CENT.

Range	Below ·10.	·10–·50.	·50–1·0.	1·0–2·0.	2·0–5·0.	5·0–10·0.	10·0–15·0.	15·0 and above.	No. of Samples Examined.
Surface	18	50	5	4	23	....	....	....	22
Subsoil	6	....	....	5	25	25	30	15	20

REPLACEABLE CALCIUM AND SODIUM.
(Per cent. of Total Replaceable Metallic Cations.)

Range		Below 5.	5–10.	10–20.	20–30.	30–40.	40–50.	50 and above.	No. of Samples Examined.
Surface	Ca	....	....	4	....	9	35	52*	23
	Na	35	22	35	4	4	....	....	23
Subsoil (3rd foot)	Ca	9	18	59	9	5	....	....	22
	Na	5	....	....	4	45	41	5	22

* 26 per cent. in 50–60 per cent. range and 26 per cent. in 60 per cent. and above range.

The figures presented in the appendix for calcium carbonate are calculated from carbonate (CO_2) which is determined by treatment of the soil with cold, dilute acid. As the soil carbonate is in combination with magnesium, as well as calcium, expression of the result as calcium carbonate is not strictly accurate. The results presented do not render it possible to calculate the exact composition of the carbonate fraction, but an approximation may be made. Assuming that all of the calcium determined by digestion with concentrated hydrochloric acid occurs in the carbonate form, and that the remainder of the carbonate is combined with magnesium, it has been shown in Table E of the appendix that about 60 per cent. of the magnesium in the soil is accounted for. This indicates that some of the carbonate probably occurs as dolomite, an equivalent mixture of calcium and magnesium carbonates, or as magnesite, a crystalline form of magnesium carbonate, both of which are insoluble in cold, dilute acid and would not be determined by the method used for the estimation of carbonate.

Reference to Tables A-D of the appendix shows that the concentration of calcium carbonate in the fine earth fraction of the subsoil commonly ranges from 20 to 40 per cent. In addition is a considerable amount of calcium carbonate in the form of nodules and stones which also represents lime accumulation as a result of pedogenic processes. No estimate of this fraction has been made, but in the Milarup loam it probably constitutes from one-third to one-half of the soil mass in many instances.

No complete analyses have been made of the water soluble salts of soils examined in the course of this survey, but information has been reported for a large number of samples from the 3,500 Farms Scheme reconnaissance (Teakle 1939, p. 223). These results, together with data from this survey, show that the anions are predominantly chloride when the concentration of water soluble salts in the soil is above 0.4 per cent. If the chlorides be expressed as sodium chloride, the proportion as sodium chloride would be generally over 70 per cent. of the water soluble salts. At low concentrations the proportion of chloride decreases to about 20 per cent. This relationship between chlorides and the water soluble salts is illustrated in Fig. 7.

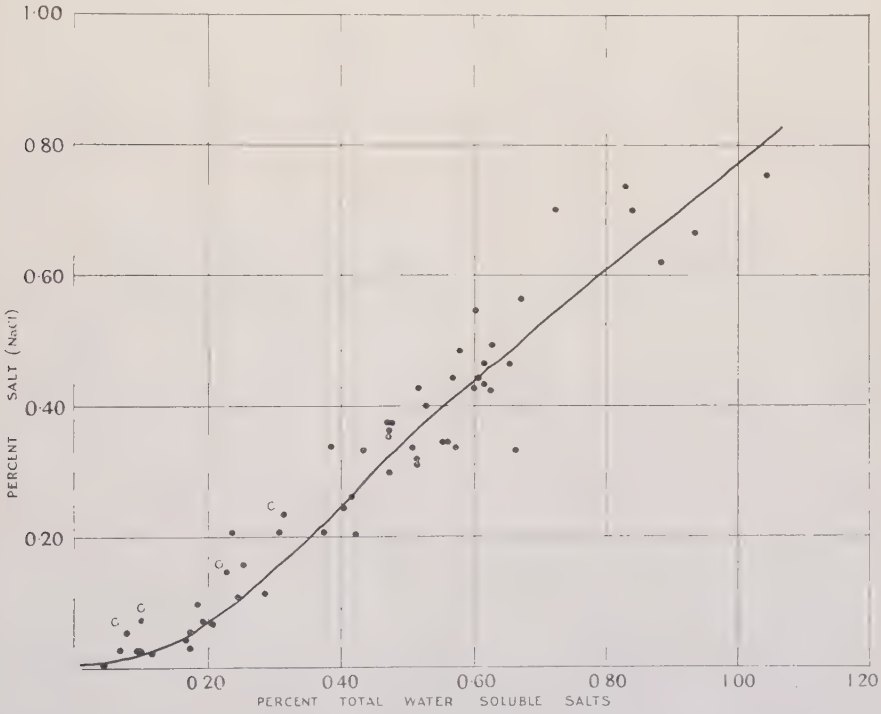

Fig 7.—Graph showing the variation in composition of the water soluble salts with increasing concentration. The four points labelled G represent the Gulson sandy loam and show an unusually high proportion of chloride.

Study of the distribution of water soluble salts with depth in the profile shows a very rapid increase in concentration from the surface to a depth of about two feet. Below that depth changes in concentration are relatively small, and increases in some cases and decreases in other cases are observed. Examples of four typical salt profiles are given in Fig. 8.

Taking the results of the survey as a whole, the salt concentration in the second foot is approximately double that in the surface foot. Early recognition of this fact is reflected in the standards adopted for low, medium and high alkali conditions.

With respect to the physical properties, with the exception of the Milarup series, the soils are low in the silt fraction as determined by mechanical analysis. It is interesting that the soils of the mallee zone of South Australia show the same characteristic. The coarse sand: fine sand ratio is somewhat variable, but in general the coarse sand is in excess of the fine sand. The variations between

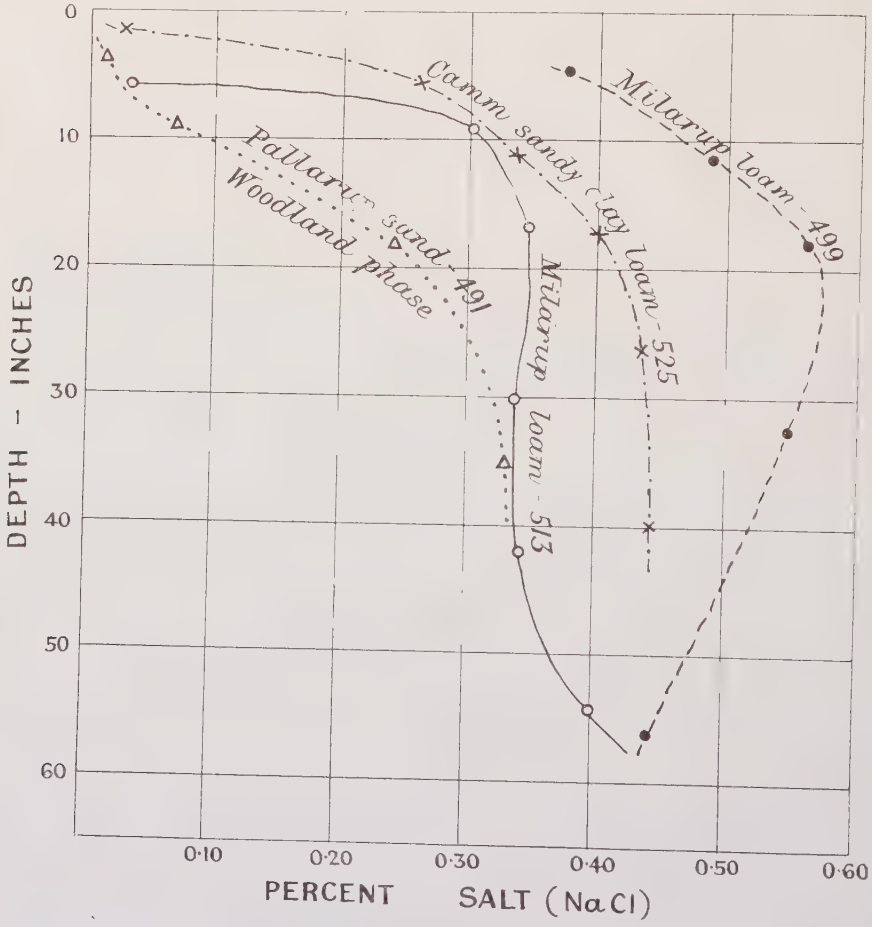

Fig. 8.—Graph showing the change in salt concentration with depth in the case of representative profiles.

the various soil series are not sufficient to indicate a wide variety of parent materials and generally the changes in the ratio with depth in the profile are hardly sufficient to be conclusive evidence of layering. It may be suspected that wind action has resulted in layering in the site selected to represent Milarup clay loam, but additional information to that supplied by the coarse sand; fine sand ratio would be necessary before this point could be established.

The Milarup series differs from the others in being relatively high in the silt fraction. The reason for this has not been determined, although it is known from a study of the results obtained by means of the hypobromite method for dispersion in mechanical analysis that a considerable proportion of the calcium carbonate falls in the silt grade. This would partly account for the silty nature of the Milarup soils as observed in the field but does not give complete explanation for the larger silt content of soils of this series.

The extent of the sandy surfaced types, in which the depth of the surface sand is not excessive, may be regarded as encouraging from the agricultural point of view. It has been established that the presence of a sandy surface results in considerable economy in moisture in that absorption is promoted and loss by evaporation is restricted. A considerable proportion of the soil types of the area, therefore, can be regarded as eminently suited for mixed farming under relatively low rainfall conditions.

3.—*The Salinity Problem.*

In a previous paper in this Journal, Teakle (1939) has shown that the woodland soils of the 3,500 Farms Scheme area south of Southern Cross are generally more saline than those of the present wheatbelt. There is no doubt that this salinity problem also affects the Lakes District and that the future manifestations of salt will be more serious than in the older settled areas. This does not mean, however, that all of the woodland and mallee scrub soils of the district are saline or useless for wheat growing. Far from it. The analyses made in the course of the soil survey show that the greater portion of the soils of the woodland and mallee group, other than those of the morrel woodland, are not saline and farming experience proves that excellent crops of wheat may be grown.

An analysis of the data from the soil survey shows that the situation with respect to soil salinity when the country was practically in the virgin state was as follows:—

(i) Soils of the salmon gum woodland.

Degree of Salinity.	Area.	Percentage.	
		Of the Group.	Of the Woodland and Mallee Scrub Soils.
	acres.		
Low	31,512	69·7	19·1
Medium	1,083	2·4	·6
High	12,573	27·9	7·6
	45,168	100·0	27·3

The bulk of the highly saline soils of this group are of the Camm sandy clay loam type (1A). These are frequently crabholey in nature, and experience in the Salmon Gums district, reported by Teakle and Burvill (1939), shows that under the rainfall conditions experienced, improvement after clearing is slow, if at all. However, in the course of the mapping of this district, certain areas

of the lighter textured Camm sandy loam (1C) were included with the saline salmon gum soils. As the Camm sandy loam soils are unlikely to give serious trouble due to salinity, it may be concluded that the figures given above for the saline types are slightly high, and in the light of experience at Salmon Gums, somewhat magnify the salinity problem in the salmon gum woodlands. Generally speaking, it will only be the heavier textured and crabholey phases which will be liable to serious damage from salinity.

(ii) *Soils of the Morrel Woodland.*

Degree of Salinity.	Area.	Percentage.	
		Of the Group.	Of the Woodland and Mallee Scrub Soils.
	acres.		
Low	19,107	32·0	11·6
Medium	256	·4	·2
High	40,337	67·6	24·4
	59,700	100·0	36·2

A large proportion of the soils of the morrel woodland, in particular the Milarup loam (4B) and the Milarup clay loam (9), must be regarded as unsatisfactory for wheat growing on two scores, one of salinity and one of unfavourable physical condition. Some of the low salinity group of this series, for instance the Milarup sandy loam, appear to be more suitable for wheat growing, but further data are required before any definite conclusions can be drawn.

(iii) *The Soils of the Gimlet and Merrit Thickets.*

Degree of Salinity.	Area.	Percentage.	
		Of the Group.	Of the Woodland and Mallee Scrub Soils.
	acres.		
Low	6,696	50·7	4·1
High	6,498	49·3	4·0
	13,194	100·0	8·1

These soils have been mapped as the Varley clay (8D) and the Barookee clay (8B). The Barookee clay (8B) covers the main area of highly saline soils in this group and must be regarded as generally unsatisfactory for agriculture in the district. The Varley clay is somewhat heavy for the general climatic conditions prevailing, but is otherwise suitable for farming.

(iv) *Soils of the Mallee Scrub.*

Degree of Salinity.	Area.	Percentage.	
		Of the Group.	Of the Woodland and Mallee Scrub Soils.
	acres.		
Low	32,247	69·0	19·6
Medium	5,286	11·3	3·2
High	9,198	19·7	5·6
	46,731	100·0	28·4

The bulk of the soils of the mallee scrub are relatively light in texture on the surface and salinity is unlikely to be serious, except on certain types of relatively restricted area. Even these, in many instances, will probably improve under a suitable cropping and pasture programme.

In addition to the area of mallee scrub detailed above, there are some 18,323 acres of low-lying country in depressions and adjacent to salt lakes which, in the virgin state, carry a type of mallee scrub vegetation. This is classed as the Hurlstone sand (5C) and is popularly referred to as lakey country. Owing to the rise in the salt water table following extensive clearing of the surrounding country, serious salinity is likely to develop in this type in the future. In older districts, considerable areas of country, similar in general features to the Hurlstone sand, have become practically useless in the course of a period of years, and, on that account, the type is mapped with the high salinity group.

Attention should be drawn to the fact that proximity to salt lakes does not necessarily indicate liability of soil types to salinity. Soil salinity is governed largely by the nature of the soil type, particularly with respect to the texture and structure, and the depth of the salt water table. In many instances, soil types adjacent to the salt lakes are of a sandy or light loamy nature, are well elevated, and, in consequence, may be developed for agriculture without danger of salt encroachment.

Only limited data of any degree of accuracy regarding crop responses on saline and non-saline soils of the district are available, and these are of little value as they refer to new land or land under its second crop. Enquiries made by Mr. A. Martin, the Agricultural Bank Inspector of the district, in 1931-32, were quite inconclusive as far as any correlation between crop yield and the salinity status of the farms could be determined. Deterioration of land as a result of salinity typically occurs with the passage of years, unless a suitable method of management can be discovered.

The situation with respect to salt was put in a general way by the then Chairman of the Agricultural Bank, the late Mr. A. McCallum ("West Australian," May 6, 1936), who stated that while many blocks which were severely affected by soil salinity were still "producing good crops, as the years have gone on, salt, to an increasing degree, had shown itself. . . . ."

4.—*Agriculture.*

The Lakes District is essentially an area suitable for mixed farming, with wheat production and stock raising as the principal activities. Sidelines may include pigs, poultry, etc., but transport difficulties will restrict diversification.

The better class soils, particularly those of the salmon gum woodland and the best of the mallee scrub types, are well suited to wheat growing and pasture production for stock raising. Wimmera rye grass, barley grass and the hardier types of clover and medics offer considerable promise. Experience in the older districts on similar soil types points to the sound nutritional value of the pasture of these soil types, especially for sheep and wool production. The results obtained in this district over the last few years confirm this opinion.

On the saline soils and snuffy morrel types, pasture production with a limited amount of cropping can be recommended on the basis of results on the Salmon Gums Research Station. Wimmera rye grass and trailing salt bush are of greatest promise, and experiments being carried out by Mr. A. S. Wild in the Lake Grace district point to the value of a number of other species. The despised barley grass is of very considerable value for early feed, particularly on the snuffy morrel types. As forage crops, barley and oats may be recommended. It is likely that the use of some cultivated crops will be necessary to maintain the vigour of the pastures on these soil types.

For the heath and wodjil soils rye is well worth a trial for feed purposes.

Encouraging results have been obtained from the use of pasture on saline soil types on the Salmon Gums Research Station. As a result of these experiments there is some evidence that a pasture cover so improves the soil conditions that satisfactory wheat crops may be obtained following a period under well-established pasture.

In the uncleared country the stock carrying capacity is very low but may be enhanced by light burning which increases production and improves the feed value of the various shrubs. Near the lakes, salt bush, when used as an adjunct to the improved pastures and stubbles, will be of value for stock purposes. It must be remembered, however, that salt bush must be handled with great care as overgrazing leads to rapid deterioration.

With respect to general agricultural practice, the experience of the wheatbelt will apply to the Lakes District. Fallowing will be necessary for wheat growing, as will also be the use of superphosphate and suitable cereal varieties planted at the correct sowing times. On account of the paramount importance of the surface soil, due to the chemical conditions discussed above, every care must be taken to control soil erosion. For this purpose over-cropping and over-stocking must be avoided and particular attention paid to pasture production as the means of restoring the soil after a period of cultivation. To this end, it is fortunate that the rainfall is reasonably reliable and generous. The spread is better than in the more northern agricultural areas of similar precipitation, and neither the winters nor the summers are severe. However, the rainfall records for the most northern part of the district, Emu Rock, are low and give warning of marginal conditions for mixed farming.

It is desirable at this point to discuss more fully the question of the soils of the morrel woodland. Frequent reference has been made above to the unsatisfactory agricultural reputation earned by these soils throughout the lower rainfall areas of the Western Australian wheatbelt. Although these soils are chemically the richest of the wheatbelt region, farming experience has proved them to be most disappointing. They produce a satisfactory growth of wheat during the wet winter months but the crop suffers in the dry spring ripening period, with resultant low grain yields. Good yields are obtained only in wet seasons.

The unsatisfactory returns are commonly associated with the snuffiness or powderiness of the surface and farmers who have had success in the handling of soils of this type have attempted to compact the surface, particularly by the use of stock, and also by the use of shallow working implements, over a period of years. However, progress is slow and the damaging effect of deep ploughing will be felt for many subsequent years.

The reasons for the unsatisfactory crop returns on morrel soils under low rainfall conditions are still obscure but a number of factors may be recognised:—

(1) These soils are very highly calcareous even on the surface, a fact which Teakle (1938) has suggested may be due to the supposed superior lime gathering propensities of the morrel timber. The occurrence of lime in the surface may be responsible for the unavailability of certain essential minerals for plant growth, with consequent nutritional disturbances of the growing crop. Experiments which have been carried out in the past have not yet pointed to any operative nutritional factor.

(2) These soils are powdery or snuffy when dry. They do not form the desirable crumb structure of good arable soils and moisture absorption is often restricted, due to hydrophobic properties.

(3) These soils show unusual capillary powers and raise water by capillary action more rapidly and to a greater height than do the other woodland soils with normal crumb structure. Furthermore, it seems that moisture will rise by capillarity in these soils from a moist subsurface in the absence of a definite water table. As such a large proportion of the soils of the morrel woodland in the Lakes District is highly saline in the virgin state, it is to be expected that, following clearing, surface accumulation of salt will result from the operation of these capillary powers. In other districts bare patches due to salt are probably more common in soils of this nature than in any other soil type.

It is indeed unfortunate that approximately half of the woodland soil types examined in the Lakes District belong to the morrel group and are of restricted value for cropping purposes. When developed, they must be regarded essentially as pasture soils; barley grass, wimmera rye grass and salt bush appear to be the most promising species.

It is unlikely that a satisfactory solution of the problems involved in the growth of satisfactory wheat crops on morrel soils will be obtained until the matter is given special attention by a team of research workers. There is no reason why a concerted attack should not yield positive results in the course of a few years and enable the fertility status of this extensive soil type to be more effectively used for the production of agricultural crops.

The water supply of the district is practically confined to excavated tanks or dams, except around the granite outcrops where wells occasionally may be located or rock catchments constructed. With the exception of the morrel types, the subsoil conditions in the woodland country provide good holding, and there should be little danger from salt water invading the dams, except on low-lying areas which are readily recognised as unsuitable for water storage.

Transport is a problem vital to the prosperity of the district and will always present difficulties on account of the distribution of the farming country. As explained above, the agricultural soils are largely confined to a valley which is very narrow over much of its length of 70 miles. This means uneconomical transportation for a district of little more than 100 settlers over a distance of 70 miles, unless railways can be built to serve farm lands further east. Under

present conditions it is necessary to develop a type of agriculture which requires a minimum of transport service, and this appears to be the policy of the settlers occupying the territory.

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APPENDIX A.

Mechanical Analyses and Chemical Data of the Soil Types.

The information with respect to mechanical analyses and chemical data for the type samples representing the main soils of the Lakes District are given in detail in Tables A-D. In securing this information the standard methods of analysis were used throughout.

Mention may be made of the fact that the quinhydrone method, using a one to one in the early work and later a one to two and a half soil-water suspension, was adopted for determination of reaction, and the sodium hydroxide dispersion method proved most satisfactory for the mechanical analysis.

Replaceable calcium and magnesium were determined by double extraction with normal sodium chloride solution. Replaceable sodium and potassium were extracted with normal ammonium chloride.

TABLE A.

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS REPRESENTING THE PALLARUP SERIES.

Soil Type	Pallarup Sand—Woodland Phase (5B).								Pallarup Sand—Mallee Scrub Phase (M8).						
Serial No.	466	467	468	469	491	492	493	494	483	484	485	486	1051	1052	1053
Horizon	A	B	B	B	A	B	B	B	A	B	B	B	A	B	B
Depth (inches)	0–6	6–14	14–27	27–43	0–7	7–11	11–25	25–43	0–6	6–12	12–24	24–40	0–7	7–14	14–28
Mechanical Analysis—Percentage of the Air Dry Fine Earth.															
Coarse Sand	52·5	29·5	27·4	22·4	63·4	40·1	20·9	22·5	51·6	38·7	23·4	20·4	59·5	42·0	34·3
Fine Sand	34·3	15·8	12·8	12·7	27·5	18·0	7·7	7·4	36·4	21·7	10·9	9·9	34·0	23·2	15·1
Silt	6·3	6·3	10·0	8·7	3·0	4·1	1·6	0·1	3·5	2·2	2·2	1·6	1·5	3·6	3·3
Clay	5·0	43·2	39·3	47·2	5·6	36·0	53·7	56·1	7·1	34·3	44·3	34·0	2·7	28·8	42·5
Coarse Sand / Fine Sand Ratio	1·53	1·87	2·14	1·76	2·31	2·23	2·72	3·04	1·42	1·78	2·15	2·06	1·75	1·81	2·27
Chemical Properties—Percentage of the Air Dry Fine Earth.															
$CaCO_3$ (from CO_2)	·2	2·2	6·3	6·4	·2	·7	14·4	15·7	·4	1·2	14·6	29·6	·05	·16	2·15
Organic Carbon	·77	·25	·19	·12	·56	·51	....	....	·54	·26	....	....	·69	·34	..
Total Nitrogen	·028	·029	·025	·02	·021	·025	....	....	·022	·022	....	....	·022	·015	
C / N Ratio	27·5	8·6	7·6	6·0	26·7	20·4	....	....	24·5	11·8	....	....	31·4	22·7	..
pH *	7·55	8·39	8·25	8·09	7·06	8·24	8·31	8·14	7·72	8·58	8·51	8·51	7·36	8·31	8·66
Constituents Soluble in Concentrated Hydrochloric Acid.															
P_2O_5	·005	....	....	·003	·004	....	....	·009	·005	....	....	·004	·013	....	·015
CaO	·091	....	....	2·88	·085	....	....	9·74	·097	....	....	15·1	·107	....	1·11
MgO	·054	....	....	·681	·122	....	....	2·08	·159	....	....	1·51	·086	....	1·01
K_2O	·277	....	....	1·85	·093	....	....	1·55	·200	....	....	1·14	·048	....	·78
Replaceable Metallic Cations.															
Total m.eq. per 100 gm. Soil	7·21	21·69	22·25	23·83	3·95	....	....	25·83	5·12	....	....	16·18	3·69	....	18·81
Total m.eq. per 100 gm. Clay	144	50·3	56·6	50·5	70·5	....	....	46·1	72·1	....	....	47·6	137	....	44·3
Ca %†	42	19	15	12	67	....	....	22	66	....	....	13	65	....	13
Mg %†	40	35	34	33	29	....	....	31	11	....	....	27	29	....	41
K %†	6	15	16	19	4	....	....	9	9	....	....	19	6	....	11
Na %†	12	31	35	36	Trace	....	....	38	14	....	....	41	....	....	35
Total Water Soluble Salts—Percentage of the Oven Dry Fine Earth.															
T.W.S.S.	·042	·245	·373	·472	·033	·206	·403	·433	·093	·286	·513	·473	....	....	....
NaCl	·007	·109	·206	·354	·010	·068	·242	·331	·025	·111	·310	·363	·01	·14	·23
NaCl / T.W.S.S. Percentage	16·7	44·5	55·2	75·0	30·3	33·0	60·0	76·4	26·9	38·8	60·4	76·7	....	....	.

* Quinhydrone electrode—soil : water ratio 1 : 1 for Serial Nos. below 1000 ; 1 : 2.5 for Serial Nos. above 1000.

† Per cent. of total replaceable metallic cations.

TABLE A—*continued.*

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS REPRESENTING THE PALLARUP SERIES—*continued.*

Soil Type	Pallarup Coarse Sandy Loam (M5).			Pallarup Gravelly Sandy Loam (M6).				Pallarup Sandy Loam (M1).			
Serial No.	1037	1038	1039	1047	1048	1049	1050	1043	1044	1045	1046
Horizon	A	B	B	A	B	B	B	A	B	B	B
Depth (inches)	0–2	2–18	18–26	0–1½	1½–7	7–21	21–42	0–2	2–8	8–21	21–35
Mechanical Analysis—Percentage of the Air Dry Fine Earth.											
Coarse Sand	49·3	24·2	17·6	50·6	28·6	18·8	20·1	54·9	37·8	22·5	9·1
Fine Sand	35·6	16·2	10·4	33·8	19·3	10·0	11·7	33·2	19·3	9·6	3·4
Silt	3·2	1·3	·1	4·5	4·9	2·9	5·3	3·2	2·7	1·4	1·1
Clay	10·6	47·3	56·4	9·0	42·3	49·4	55·7	7·5	35·3	51·6	32·4
Coarse Sand / Fine Sand Ratio	1·39	1·49	1·69	1·50	1·48	1·88	1·72	1·65	1·96	2·34	2·68
Chemical Properties—Percentage of the Air Dry Fine Earth.											
$CaCO_3$ (from CO_2)	·110	5·10	9·50	·140	·560	13·1	·95	·047	·35	9·45	49·6
Organic Carbon	·84	·86	....	1·15	·89	....	....	·77	·65	.	.
Total Nitrogen	·034	·036	..	·045	·036	.	...	·027	·029		
C / N Ratio	24·7	23·9	....	25·5	24·7	....	....	28·5	22·4	....	
pH*	6·40	8·31	8·38	6·92	8·17	8·17	8·06	6·92	8·21	8·57	8·58
Constituents Soluble in Concentrated Hydrochloric Acid.											
P_2O_5	·017	....	·019	·016	....	....	·024	·012	....	....	·013
CaO	·129	....	4·46	·142	....	....	·322	·160	....	....	15·0
MgO	·168	....	1·47	·169	....	....	·954	·207	....	....	12·1
K_2O	·151	....	·735	·109	....	....	·623	·171	....	....	·610
Replaceable Metallic Cations.											
Total m.eq. per 100 gm. Soil	4·73	....	25·14	6·29	....	....	25·30	4·79	....	....	15·13
Total m.eq. per 100 gm. Clay	44·7	....	44·6	70·0	....	....	45·4	63·8	....	....	46·7
Ca %†	69	....	20	44	....	....	7	53	....	....	4
Mg %†	24	....	38	47	....	....	47	40	....	....	41
K %†	6	....	12	4	....	....	8	6	....	....	15
Na %†	1	....	30	5	....	....	38	1	....	....	40
Total Water Soluble Salts—Percentage of the Oven Dry Fine Earth.											
T.W.S.S.	...	..	....	....	....	....	....	....	....	....	....
NaCl	·01	·24	·42	·04	·25	·50	·70	·01	·23	·41	·41
NaCl / T.W.S.S. Percentage	...	...	.	...	..	..	..	..	.	...	

* Quinhydrone electrode—soil : water ratio 1 : 1 for Serial Nos. below 1000 ; 1 : 2.5 for Serial Nos. above 1000.

† Per cent. of total replaceable metallic cations.

TABLE B.

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS OF THE CAMM AND CARMODY SERIES.

	Camm Sandy Clay Loam (1A).										Camm Sandy Loam (1C).				Carmody Sand (7).			
Serial No.	525	526	527	528	529	530	211	212	213	214	504	505	506	507	536	537	538	539
Horizon	A	B	B	B	B	B	A	B	B	B	A	B	B	B	A	B	B	B
Depth (inches)	0–3	3–8	8–14	14–20	20–31	31–48	0–4	4–10	10–30	30–48	0–5	5–8	8–21	21–42	0–5	5–10	10–18	18–32
Mechanical Analysis—Percentage of the Air Dry Fine Earth.																		
Coarse sand	51·6	39·4	27·2	20·7	16·6	17·9	44·1	15·1	15·0	19·4	56·6	44·7	21·0	19·5	49·4	51·1	45·0	47·5
Fine sand	25·5	20·6	11·5	10·1	8·7	8·4	34·0	12·0	8·9	12·8	23·0	19·7	9·1	8·4	30·3	26·8	28·7	25·7
Silt	6·1	4·8	2·5	1·6	1·2	1·4	6·5	3·7	2·1	1·0	7·6	8·4	5·2	6·4	3·4	3·4	3·6	3·4
Clay	14·0	31·3	50·8	58·2	54·3	50·9	11·4	41·7	32·9	43·0	8·2	23·5	50·2	49·9	15·7	17·0	20·7	22·4
Coarse sand / fine sand ratio	2·02	1·91	2·37	2·05	1·91	2·13	1·30	1·26	1·69	1·52	2·46	2·27	2·31	2·32	1·63	1·91	1·57	1·85
Chemical Properties—Percentage of the Air Dry Fine Earth.																		
$CaCO_3$ (from CO_2)	*Nil*	·1	2·8	2·7	14·5	18·8	·08	19·6	39·0	17·8	·1	·1	8·1	9·5	*Nil*	*Nil*	*Nil*	*Nil*
Organic carbon	·90	·59	....	.	. .	...	1·31	1·26	...	..	1·49	·78	·29	·23	·46	·40	.	. .
Total nitrogen	·056	·044	...	...	.	....	·055	·078	...	.	·059	·056	·028	·011	·027	·029	..	. .
C / N ratio	16·1	13·4	....	....	....	....	23·8	16·2	....	....	25·3	13·9	10·4	20·9	17·0	13·8	..	. .
pH*	7·41	7·93	8·38	8·38	8·52	8·55	6·82	8·31	8·42	8·42	7·38	7·38	7·75	8·02	5·81	5·51	5·29	5·49
Constituents Soluble in Concentrated Hydrochloric Acid.																		
P_2O_5	·011	....	....	....	·009	....	·008	....	....	·01	·007	....	....	·006	·005	. .	.	·006
CaO	·076	...	.	....	4·28	....	·199	....	....	5·10	·151	....	....	4·95	·024	. .	. .	·005
MgO	·396	....	....	....	3·20	....	·298	....	....	4·25	·296	....	....	1·48	·012	. .	.	·009
K_2O	·438	....	....	....	1·73	....	·203	....	....	·735	·319	....	....	1·43	·053	...	.	·061
Replaceable Metallic Cations.																		
Total m.eq. per 100 gm. Soil	3·80	....	....	....	20·05	....	10·54	....	....	20·83	9·90	16·14	27·44	26·13	1·55	.	..	1·36
Total m.eq. per 100 gm. Clay	27·2	.	.	. .	36·9	.	92·5	....	....	48·4	121	68·7	54·7	52·3	9·9	....	....	6·07
Ca%†	47	....	....	....	8	....	52	....	....	4	42	23	19	15	57	....	....	18
Mg%†	10	....	....	....	24	....	38	....	....	35	36	42	37	36	19	....	....	62
K%†	24	....	....	....	25	....	6	....	....	12	7	9	10	10	19	....	....	18
Na%†	19	....	....	....	43	....	4	....	....	49	15	26	34	39	5	....	....	2
Total Water Soluble Salts—Percentage of the Oven Dry Fine Earth.																		
T.W.S.S.	·096	·418	·508	·530	·616	·608	....	....	....	....	·069	·237	·385	·517	·032	·038	·050	·046
NaCl	·027	·260	·333	·400	·433	·443	....	....	....	....	·029	·202	·338	·428	·006	·007	·007	·017
NaCl / T.W.S.S %	28	62	66	76	70	73	....	....	....	....	42	85	88	83	19	18	14	37

* Quinhydrone electrode—soil : water ratio 1 : 1, except for Serial Nos. 211–214, for which 1 : 2·5.

† Per cent. of total replaceable metallic cations.

TABLE C.

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS REPRESENTING THE MILARUP SERIES.

	Milarup Loam (4B).															
Serial No.	470	471	472	473	495	496	497	498	499	500	501	502	513	514	515	516	517
Horizon	A	B	B	B	A	B	B	B	A	B	B	B	A	B	B	B	B
Depth (inches)	0–5	5–13	13–28	28–43	0–6	6–16	16–26	26–42	0–9	9–13	13–22	22–41	0–6	6–11	11–22	22–36	36–48
Mechanical Analysis—Percentage of the Air Dry Fine Earth.																	
Coarse Sand	40·6	33·3	32·0	27·0	19·8	14·9	11·7	10·2	26·1	23·3	21·7	19·5	38·5	30·7	28·9	22·5	22·1
Fine Sand	16·5	16·2	15·0	13·4	11·6	10·1	6·2	4·9	11·1	10·6	8·5	6·4	16·7	16·5	14·9	11·9	11·6
Silt	14·2	13·4	11·3	7·7	22·0	18·8	6·8	5·0	22·7	15·7	10·2	3·3	10·1	9·0	6·8	6·0	4·9
Clay	14·9	16·1	17·7	19·9	32·5	32·3	41·0	44·2	20·9	27·5	32·9	35·3	19·3	20·0	21·5	18·5	20·9
Coarse Sand / Fine Sand Ratio	2·46	2·06	2·13	2·02	1·71	1·48	1·89	2·08	2·35	2·20	2·55	3·05	2·30	1·86	1·94	1·89	1·90
Chemical Properties—Percentage of the Air Dry Fine Earth.																	
$CaCO_3$ (from CO_2)	7·5	16·3	21·2	30·4	4·7	16·4	28·3	30·6	9·2	15·3	20·1	28·2	7·7	17·8	21·9	39·9	42·2
Organic Carbon	2·41	·80	·47	·31	1·71	·59	....	....	1·47	·72	....	....	1·88	·96	....	....	....
Total Nitrogen	·143	·056	·032	·015	·111	·052	....	....	·092	·059	....	....	·127	·066	....	....	....
C / N Ratio	16·9	14·3	14·7	20·7	15·4	11·3	....	....	16·0	12·2	....	....	14·8	14·5	....	....	....
pH*	8·36	8·42	8·60	8·51	7·92	8·31	8·34	8·29	8·25	8·28	8·49	8·59	8·00	8·17	8·41	8·58	8·41
Constituents Soluble in Concentrated Hydrochloric Acid.																	
P_2O_5	·033	....	....	·008	·022	....	....	·006	·018	....	....	·007	·025	....	....	·006	....
CaO	4·07	....	....	11·95	2·82	....	....	15·60	4·91	....	....	14·97	4·65	....	....	13·40	....
MgO	·170	....	....	4·56	·90	....	....	2·26	1·56	....	....	2·34	1·34	....	....	7·59	....
K_2O	1·10	....	....	1·06	1·80	....	....	1·51	1·59	....	....	1·20	1·03	....	....	·842	....
Replaceable Metallic Cations.																	
Total m.eq. per 100 gm. Soil	25·74	19·32	16·50	14·48	33·38	....	....	22·91	31·30	....	....	16·91	24·46	....	....	12·85	....
Total m.eq. per 100 gm. Clay	173	121	93·2	72·8	103	....	....	51·8	150	....	....	47·9	127	....	....	69·5	....
Ca% †	49	19	10	12	54	....	....	14	34	....	....	11	65	....	....	11	....
Mg% †	22	26	24	20	23	....	....	27	30	....	....	27	22	....	....	31	....
K% †	12	20	25	24	11	....	....	17	15	....	....	22	9	....	....	20	....
Na% †	17	35	41	44	12	....	....	42	21	....	....	40	4	....	....	38	....
Total Water Soluble Salts—Percentage of the Oven Dry Fine Earth.																	
T.W.S.S.	·421	·615	·569	·600	·513	·830	·840	·723	·471	·579	·671	·601	·192	·472	·560	·572	·556
NaCl	·203	·465	·443	·428	·319	·737	·700	·700	·375	·486	·564	·548	·070	·297	·343	·336	·343
NaCl / T.W.S.S. %	48·3	75·6	78·8	71·4	62·2	88·8	83·3	96·8	79·7	83·9	84·1	91·2	36·5	63·0	61·3	58·8	61·7

* Quinhydrone electrode—soil : water ratio 1 : 1 for Serial Nos. below 1,000 ; 1 : 2·5 for Serial Nos. above 1,000.

† Percentage of total replaceable metallic cations.

TABLE C—*continued.*

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS REPRESENTING THE MILARUP SERIES—*continued.*

	Milarup Sandy Loam (4A).												Milarup Clay Loam (9).					
Serial No.	474	475	476	477	487	488	489	490	531	532	533	534	1031	1032	1033	1034	1035	1036
Horizon	A	B	B	B	A	B	B	B	A	B	B	B	A	B	B	B	B–C	
Depth (inches)	0–5	5–12	12–22	22–40	0–5	5–12	12–25	25–40	0–6	6–12	12–26	26–39	0–7	7–15	15–40	40–73	73–90	90–116
Mechanical Analysis—Percentage of the Air Dry Fine Earth.																		
Coarse Sand	41·6	29·4	19·1	16·3	38·0	27·5	20·6	20·4	54·4	47·3	37·6	33·1	14·2	8·6	7·8	4·4	4·8	6·9
Fine Sand	23·1	17·0	9·6	7·3	19·0	16·9	11·5	8·9	22·9	22·3	18·4	14·9	20·9	13·2	5·1	4·4	5·7	8·8
Silt	8·1	6·1	2·6	2·2	15·9	12·1	8·6	6·5	4·4	5·8	5·2	4·9	33·5	22·6	5·9	5·7	6·7	4·6
Clay	21·5	40·1	41·8	37·9	20·5	37·8	42·7	43·3	15·9	22·8	32·4	37·0	19·2	44·4	53·7	48·7	59·4	69·9
Coarse Sand / Fine Sand Ratio	1·80	1·73	1·99	2·23	2·00	1·63	1·79	2·29	2·38	2·12	2·04	2·22	·68	·65	1·53	1·0	·84	·78
Chemical Properties—Percentage of the Air Dry Fine Earth.																		
$CaCO_3$ (from CO_2)	*Nil*	2·0	22·3	37·8	·20	·50	13·8	19·5	·05	·10	3·6	5·0	·58	·75	21·8	32·3	14·8	·46
Organic Carbon	1·25	....	....	....	1·26	·57	....	....	·78	·34	....	....	1·52	·56	....	....	.	.
Total Nitrogen	·060	....	....	....	·059	·035	....	....	·039	·027	....	....	·120	·039	.	.	.	.
C / N Ratio	20·8	....	....	....	21·3	16·3	....	....	20·0	12·6	....	....	12·7	14·4	.	.	...	. .
pH*	6·40	8·14	8·57	8·73	7·58	7·92	8·14	8·27	8·03	8·07	8·45	8·45	8·40	8·66	8·34	8·28	8·14	6·74
Constituents Soluble in Concentrated Hydrochloric Acid.																		
P_2O_5	·009	....	....	·004	·014	....	....	·013	·017	....	....	·013	·057	....	·047		. .	. .
CaO	·256	....	....	10·25	·489	....	....	9·97	·200	....	....	2·70	·76	....	10·5		.	. .
MgO	·524	....	....	8·60	·551	....	....	2·08	·126	....	....	1·42	1·26	....	3·36	.	.	...
K_2O	·739	....	....	1·23	1·06	....	....	1·57	·512	....	....	1·28	·305	....	·817	..	. . .	. .
Replaceable Metallic Cations.																		
Total m.eq. per 100 gm. Soil	18·91	....	....	20·95	22·11	....	....	20·77	7·58	....	....	14·51	31·78	....	23·07	....	. . .	....
Total m.eq. per 100 gm. Clay	88·0	....	....	55·3	108	....	....	47·8	47·7	....	....	39·2	165	....	43·0			
Ca%†	42	....	....	21	58	....	....	36	83	....	....	18	44	....	15	.		
Mg%†	40	....	....	26	24	....	....	24	2	....	....	22	26	....	28			.
K%†	7	....	....	16	12	....	....	19	13	....	....	26	16	....	17			..
Na%†	11	....	....	37	6	....	....	21	2	....	....	34	14	....	40		.	
Total Water Soluble Salts—Percentage of the Oven Dry Fine Earth.																		
T.W.S.S.	·166	·473	·663	·653	·116	·173	·183	·253	....	....	....	....	....	....	....	....	....	.
NaCl	·041	·297	·331	·465	·021	·053	·096	·167	·015	·075	·150	·230	·02	·06	·61	1·28	1·95	1·39
NaCl / T.W.S.S. %	24·7	62·8	50·0	71·2	18·1	30·7	52·5	66·0	....	....	....	....	....	....	....	....	....	..

*Quinhydrone electrode—soil : water ratio 1 : 1 for Serial Nos. below 1,000 ; 1 : 2·5 for Serial Nos. above 1,000.

† Percentage of total replaceable metallic cations.

TABLE D.

MECHANICAL ANALYSES AND CHEMICAL DATA OF SOILS OF THE GULSON AND BAROOKEE SERIES AND SUBTYPES 1B AND 1D.

	Gulson Sandy Loam (1S).				Subtype 1D.			Subtype 1B.					Barookee Clay (8B).			
Serial No.	508	509	510	511	1040	1041	1042	519	520	521	522	523*	479	480	481	482
Horizon	A	B	B	B	A	B	B	A	B	B	B	B	A	B	B	B
Depth (inches)	0–7	7–13	13–23	23 33	0–2	2–18	18–26	0–2½	2½–8	8–22	22–27	27- 40	0–8	8–22	22–36	36–44
Mechanical Analysis—Percentage of the Air Dry Fine Earth.																
Coarse Sand	31·3	30·1	29·8	24·4	41·3	19·8	31·9	46·6	28·4	16·9	23·3	23·7	21·2	14·6	15·7	16·8
Fine Sand	18·0	17·4	15·4	12·1	25·2	9·2	9·4	28·6	18·3	8·8	12·3	16·4	18·1	10·0	10·3	12·0
Silt	19·0	16·4	14·0	6·3	4·2	2·2	6·6	5·5	3·8	3·2	3·8	10·0	9·6	6·0	5·3	5·8
Clay	20·8	26·5	29·9	34·0	24·4	61·6	48·9	17·5	43·5	48·5	54·8	43·5	38·8	37·9	42·9	47·4
Coarse Sand / Fine Sand Ratio	1·74	1·73	1·93	2·02	1·64	2·15	3·39	1·63	1·55	1·92	1·89	1·44	1·17	1·46	1·52	1·40
Chemical Properties—Percentage of the Air Dry Fine Earth.																
$CaCO_3$ (from CO_2)	2·2	3·8	6·6	18·2	·11	·12	·055	*nil*	·6	16·8	·8	*nil*	6·7	28·5	21·9	13·5
Organic Carbon	1·35	·55	....	....	1·51	·63	....	·85	·63	....	....	....	1·04	·33	·18	·21
Total Nitrogen	·085	·048	....		·070	·034	..	·050	·043				·056	·032	·022	·034
C / N Ratio	15·9	11·5	....	....	21·6	18·5	....	17·0	14·6	....	....	....	18·6	10·3	8·2	6·2
pH†	8·32	8·79	8·66	8·52	7·09	7·86	6·97	7·70	8·0	8·0	7·73	7·73*	8·31	8·36	8·25	8·14
Constituents Soluble in Concentrated Hydrochloric Acid.																
P_2O_5	·023	....	....	·013	·019	....	·015	·009	....	....	....	....	·004	....	Trace	
CaO	1·60	....	....	7·42	·217	....	·099	·135	....	....	....	....	3·01	....	6·18	
MgO	1·26	....	....	3·37	·452	....	·456	·364	....	....	....	....	·774	....	4·45	
K_2O	1·19	....	....	1·15	·385	....	·497	·355	....	....	....	....	1·08	....	1·04	
Replaceable Metallic Cations Air Dry.																
Total m.e.q. per 100 gm. Soil	27·83	....	18·18	....	14·96	....	13·28	11·32	....	....	....	16·60	26·45	22·36	22·33	24·94
Total m.e.q. per 100 gm. Clay	134	....	60·8	....	61·3	....	27·1	64·7	....	....	....	38·1	68·2	59·0	52·0	52·6
Ca %‡	55	....	12	....	32	....	10	47	....	....	....	7	14	10	6	5
Mg %‡	31	....	28	....	53	....	45	39	....	....	....	43	36	30	30	35
K %‡	12	....	19	....	7	....	12	9	....	....	....	11	11	11	13	10
Na %‡	2	....	41	....	8	....	33	5	....	....	....	39	39	49	51	50
Total Water Soluble Salts. Percentage of Oven Dry Fine Earth.																
T.W.S.S.	·078	·100	·228	·314	....	....	....	·172	·306	·628	·904	·800	·626	·882	·934	1·042
NaCl	·054	·074	·148	·235	·26	·43	·43	·030	·208	·494	·718	·715	·422	·62	·666	·752
NaCl / T.W.S.S. Percentage	69	74	65	75	....	....	....	17	68	63	79	89	68	70	71	72

* pH of 40–60-inch layer, 5·48.

† Quinhydrone electrode—soil : water ratio 1 : 1 for Serial Nos. below 1000 ; 1 : 2·5 for Serial Nos. above 1000.

‡ Per cent. of total replaceable metallic cations.

APPENDIX B.

Mechanical Analysis by the Hypobromite Method.

As many of the samples examined contained a considerable proportion of calcium carbonate in the fine earth fraction, a number of samples were examined by the hypobromite method and the results compared with the International Method. In the International Method calcium carbonate is destroyed by acid treatment and the removal of a considerable portion of the mineral fraction of the soil will undoubtedly affect any interpretation of the mechanical analysis. So that this important fraction of the soil minerals may be included in the mechanical analysis, the hypobromite method may be used, whereby the organic matter is destroyed and the colloids dispersed without the removal of the calcium carbonate.

In order to compare the results of the two methods the percentages of the fraction determined in mechanical analysis by the International Method have been calculated on the basis of these fractions plus calcium carbonate. The differences in the percentage of each fraction obtained by the two methods of analysis should give a measure of the distribution of the calcium carbonate between these fractions. These comparisons are set out in Table E, which shows:—

(1) The hypobromite method was considerably less effective than sodium hydroxide as a dispersing agent for the clays of these soils.*

(2) A considerable proportion of the calcium carbonate appears to fall in the silt fraction.

*Destruction by strong hydrochloric acid of the calcium carbonate of the sand fractions separated by the hypobromite method liberated a small amount of clay which was apparently trapped as the calcium carbonate was deposited in the soil mass. This fact accounts, in part, for the disparity in the clay figures for the two methods after making allowance for calcium carbonate.

APPENDIX C.

The partitioning of calcium and magnesium in carbonate fraction.

In Table F the analyses for carbonate, calcium and magnesium have been calculated in terms of chemical equivalents, so that the possible partitioning of the calcium and magnesium in the carbonate fraction can be calculated. The analyses of non-carbonate soils, or soils low in carbonate, show that the calcium content, other than in the carbonate form, is relatively low, probably of the order of magnitude of 0.1 to 0.2 per cent. It may reasonably be assumed, therefore, that the calcium in the calcareous soils was predominantly in combination with carbonate, and, for purposes of calculation, it is assumed that the total calcium is combined in this form. A certain amount of the magnesium will be combined in the non-carbonate soil minerals and the remainder will be located in the carbonate fraction. Portion of the magnesium in excess of that equivalent to the residual carbonate may be in the form of dolomite, and as magnesite, a crystalline form of magnesium carbonate. These magnesium compounds are relatively resistant to the attack of cold dilute hydrochloric acid, so that portion of the carbonate fraction in the soil may not have been determined by the Hutchinson-McLennan method used in this work. The amount of magnesium which could combine with the residual carbonate, as determined after combination with the

calcium, is shown in the final column. From these results it has been calculated that, on the average, approximately 60 per cent. of the total magnesium can be accounted for in this manner, leaving about 40 per cent. which must be in combination in non-carbonate minerals or as insoluble carbonates in the soil.

APPENDIX D

List of local and botanical names.

Local name.	*Botanical name.*
salmon gum	*Eucalyptus salmonophloia.*
morrel (red)	*E. oleosa var. longicornis*
morrel (black)	*E. melanoxylon*
gimlet	*E. salubris*
Kondinin blackbutt	*E. Kondininensis*
merrit	*E. Flocktoniae*
redwood	*E. oleosa var. transcontinentalis*
yorrell	*E. gracilis*
swamp gimlet	*E. spathulata*
York gum mallee	*E. foecunda*
sand salmon gum	*E. leptophylla*
mallees (white)	*E. dumosa*
„ (black)	*E. oleosa*
„ (red)	*E. eremophila*
„ (ring gum)	*E. annulata*
boree (ordinary)	*Melaleuca pauperiflora*
„ (forbor)	*M. quadrifaria*
broom bush	*M. uncinata*
umbrella bush	*M. cardiophylla*
blue teatree	*M. pentagona*
jam	*Acacia acuminata*
claybush	*A. sericocarpa* *A. Graffiana*
needle bush	*Daviesia aphylla*
centipede bush	*Templetonia sulcata*
salt bush	*Atriplex sp.*
hop	*Dodonea stenozyga*
quondong	*Santalum acuminatum*
daisy	*Olearia Muelleri*
rosemary	*O. revoluta*
navy bush	*Halgania lavandulacea*
boxthorn	*Lycium australe*
grey bush	*Cratystylis conocephala*
native cherry	*Exocarpus aphylla*
boronia	*Boronia xerophila*

TABLE E.

Differences in the results of mechanical analyses of soils of the Lakes District by the Standard method and the Hypobromite method.

The values for the individual fractions were obtained by calculating the Percentage on the total fractions plus Calcium Carbonate in the Standard method and on the total fractions in the Hypobromite method. The differences were obtained by subtracting the figures for the Standard method from those for the Hypobromite method. The algebraic sum of the differences for any one sample is equivalent to the percentage of Calcium Carbonate in the mineral fraction.

Soil Type	Csel	Csel	Csl	Psl	Msl	Msl	Msl	Msl	Msl	Ml	Ml	Ml	Ml	Ml	Ml	Mcl	ID
Serial No.	212	213	506	1046	474	475	476	487	488	471	472	495	496	499	500	1033	511
Depth (inches)	4-10	10-30	8-21	21-35	0-5	5-12	12-22	0-5	5-12	5-13	13-28	0-6	6-16	0-9	9-13	15-40	23-33
Coarse Sand	1.4	2.0	3.2	19.7	.5	-1.4	9.1	.9	-.4	2.4	3.3	1.3	2.0	-.1	-.8	5.4	3.2
Fine Sand	4.9	2.9	7.9	7.5	1.2	2.0	8.0	1.1	.2	4.9	7.4	8.1	7.8	3.3	5.3	6.6	9.4
Silt	16.4	26.7	30.6	28.2	8.1	8.9	13.0	7.0	7.7	7.9	9.0	13.5	13.3	8.8	16.5	17.3	17.6
Clay	-1.4	8.1	-33.0	-3.6	-9.8	-7.4	-6.7	-8.8	-7.0	1.9	2.1	-17.7	-5.3	-1.8	-4.5	-6.3	-11.0
Algebraic total (equivalent to $CaCO_3$)	21.3	39.7	8.7	51.8	nil	2.1	23.4	.2	.5	17.1	21.8	5.2	17.8	10.2	16.5	23.0	19.2

Csel = Camm sandy clay loam.
Psl = Pallarup sandy loam.
Msl = Milarup sandy loam.
Ml = Milarup loam.
Mcl = Milarup clay loam.

TABLE F.

On the assumption that all of the Calcium is combined with Carbonate, this table shows the Total Magnesium and the amount of Magnesium that could combine with the Residual Carbonate in the soil.

Analyses and calculations expressed as chemical equivalents per 100 gm. Air Dry Fine Earth.

Serial No.	Soil Series.	Depth.	Carbonate.	Calcium.	Magnesium.	Magnesium which could combine with Residual Carbonate.
		inches.				
469	Pallarup ...	27–43	.128	.103	.034	.025
486	do. ...	24–40	.592	.540	.076	.052
494	do. ...	25–43	.314	.348	.104	—.034
1039	do. ...	18–26	.190	.159	.074	.031
1046	do. ...	21–35	.992	.536	.605	.456
1053	do. ...	14–28	.043	.040	.050	.003
214	Camm ...	30–48	.356	.182	.212	.174
507	do. ...	21–42	.190	.177	.074	.013
529	do. ...	20–31	.290	.153	.160	.137
470	Milarup ...	0– 5	.150	.145	.008	.005
473	do. ...	28–43	.608	.428	.228	.180
477	do. ...	22–40	.756	.366	.430	.390
490	do. ...	25–40	.390	.356	.104	.034
495	do. ...	0– 6	.094	.101	.045	—.007
498	do. ...	26–42	.612	.556	.113	.056
499	do. ...	0– 9	.184	.175	.078	.009
502	do. ...	22–41	.564	.535	.117	.029
513	do. ...	0– 6	.154	.166	.067	—.012
516	do. ...	24–36	.798	.478	.380	.320
1031	do. ...	0– 7	.012	.027	.063	—.015
1033	do. ...	15–40	.436	.375	.168	.061
508	Gulson ...	0– 7	.044	.057	.063	—.013
479	Barookee ...	0– 8	.134	.108	.039	.026
481	do. ...	22–36	.438	.220	.222	.218
	Average ...	...	...	...	.146	.089
	Per cent. ...	...	...	...	100	60

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Stored-grain Pests.

C. F. H. Jenkins, Government Entomologist.

INTRODUCTION.

Stored foodstuffs such as grain, dried fruits and flour are constantly liable to the attacks of insect pests, with the result that the farmer, grain merchant, miller and grocer have a continual war to wage in order to keep their products in a wholesome condition.

At the present critical stage in Australia's history, the importance of storage pests, usually known to the trade as "weevils," is so vital that it is the duty of every individual to see that the utmost is done to combat the depredations of these tiny but nevertheless powerful enemies.

During the 1914-18 World War, millions of bushels of bagged wheat were stored in Australia on account of the lack of shipping space, and incalculable damage was done by mice and "weevil" attack. Due to the present war conditions there is every possibility of large stocks of wheat accumulating in this State, but we must profit from previous experience and see that rodent and insect damage is reduced to a minimum.

The farmer may think that this is a matter for the Government or for the merchant who holds the wheat, but the responsibility cannot be shelved in that manner, for although this view may be partly correct, the first responsibility lies with the farmer himself.

Before dealing with the methods which may be adopted to safeguard the grain, it will be well to know the names of the insects with which we are concerned, how they may be recognised and the way in which they affect the wheat.

Grain insects may be divided into two main groups which can be listed as follows:—

I. *Primary Insects.*—Those capable of affecting sound grain—
- Rice weevil (*Calandra oryzae* L.).
- Granary weevil (*C. granaria* L.)
- Lesser grain borer (*Rhizopertha dominica* Fabr.).
- Angoumois grain moth (*Sitotroga cerealella* Oliv.).

II. *Secondary Insects.*—Those incapable of attacking sound grain—
- Confused flour beetle (*Tribolium confusum* Jacq.-Duv.).
- Rust-red flour beetle (*T. castaneum* Herbst.).
- Saw toothed grain beetle (*Oryzaephilus surinamensis* L.).
- Flat grain beetles (*Laemophloeus* spp.).

There is a belief prevalent even in these times that "weevils" appear spontaneously in grain just as toads were believed by the ancients to be the product of mud and slime, and flies an inevitable sequel to filth. That there is absolutely no foundation for this will be seen from the life history details which follow. Clean wheat will remain free from insect attack indefinitely if no outside infection is permitted. Every "weevil" is derived from an egg laid by a female and there is definitely nothing spontaneous or mysterious about an outbreak, however obscure the source of infestation may be.

PRIMARY PESTS.

Rice Weevil (*Calandra oryzae* L.). (Fig 1.)

Sometimes known as the black weevil, this insect varies considerably in size, but seldom exceeds one-eighth of an inch in length. The size is readily gauged from a comparison with a wheat grain in the accompanying illustration.

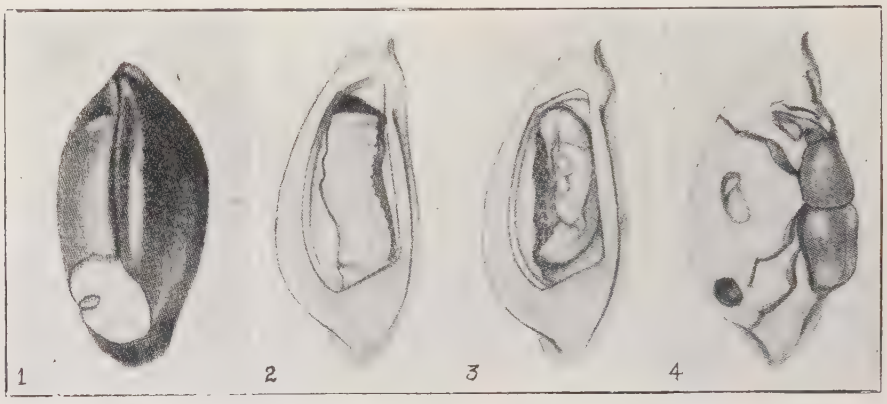

Figure 1.

Life stages of Rice Weevil in wheat. 1.—Grain dissected to show egg. 2.—Well grown larva. 3.—Pupa. 4.—Adult feeding upon kernel. Note in 4 the hole in lower portion of kernel made by the adult on leaving the seed. The other shallower holes were made by the adult in feeding after emergence.

[From U.S. Dept. Agri.]

Being a true weevil the head is produced into a long snout at the end of which the mouth parts are borne. The colour varies from reddish brown to almost black and usually four light-coloured spots are distinguishable on the back. The thorax is densely pitted with round punctures.

Beneath the wing covers are a pair of fully developed wings and although the insect is seldom seen in flight, it is quite capable of adopting this method of progression.

In some countries indeed these weevils fly from the barns into the fields and attack standing grain, but careful observations have failed to reveal any such tendencies in this State and it is considered that summer conditions are unsuitable for the field activity of this insect.

The adult weevil can live for a considerable period, published figures varying from four to eight months, and during this time 300 to 1,000 eggs may be laid.

Before laying her eggs, the female bores a small hole with her mandibles into the wheat grain and therein deposits an egg. This is then covered with a gelatinous fluid which entirely plugs the hole. The fat, legless grub which emerges after three or four days feeds in the grain for about a fortnight and then pupates to emerge as an adult weevil at the end of about a week. It will be seen, therefore, that from egg to adult occupies from three weeks to a month. This time varies greatly according to temperature and humidity, and under cool conditions would be greatly increased. Below an average temperature of 50°F. weevil activity is considerably checked, but in this State the mean monthly temperature falls below 50°F. in but a few districts and then for only a short period. Weevils when working in wheat themselves tend to raise its temperature so that our winter conditions cannot be regarded as a serious check upon the pest.

Granary Weevil (*Calandra granaria* L.). (Fig. 2.)

The granary weevil is reddish brown to black in colour, and about the same size as the Rice Weevil from which it may be distinguished by the lack of the light spots on the wing covers and the presence of elongated instead of circular punctures on the thorax. Another important difference is the absence of flight wings.

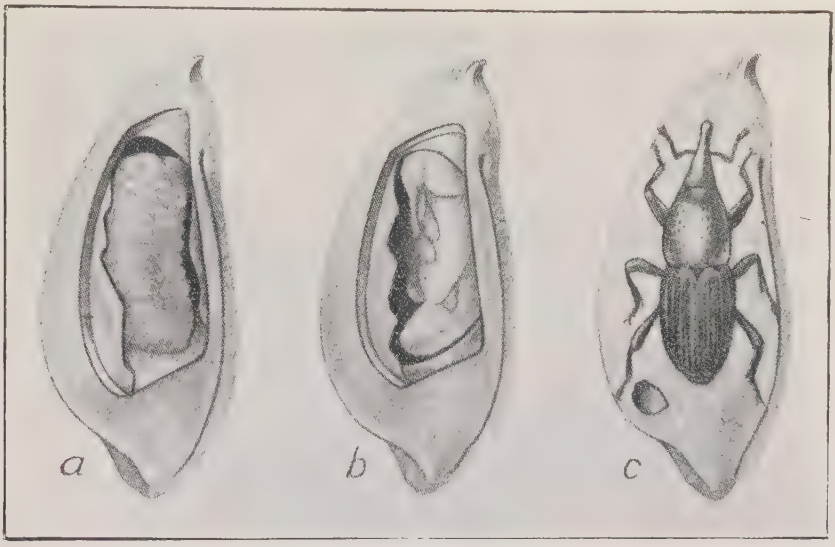

Figure 2.
Life stages of Granary Weevil in wheat. a, Well grown larva; b, pupa; c, adult.
[From U.S. Dept. Agri.]

As in the case of the rice weevil, the adults and grubs feed voraciously on grain, and the life history and habits of the two are so similar as to require little further comment.

The grain weevil, although usually associated with the rice weevil, prefers a temperate climate and considerable damage is not experienced locally from this species with the possible exception of some of the extreme southern regions.

The Lesser Grain Borer (*Rhizopertha dominica* Fabr.). (Fig. 3 and 3a.)

The lesser grain borer is not a true weevil, but belongs to the same group as many of the timber borers (Bostrichidae). It is one of the smallest grain pests, but one of the most serious in this country.

During the last war many shipments of Australian wheat were heavily infested by this beetle and it became known abroad as the Australian wheat weevil, although its native home is probably India. It is cylindrical in shape, dark brown or black, and about one-eighth of an inch in length.

Both the adults and the larvæ are responsible for serious damage to a variety of grains. The beetles may live for a period of up to four months and during that period lay 300 to 500 eggs. The eggs are laid singly or in clusters in the loose grain, and the young larvæ feed upon any floury material present or bore into grain damaged by the attack of the parents. They are generally incapable of entering a sound grain. From egg to adult is said to occupy about a month under favourable conditions, but may be extended to several months.

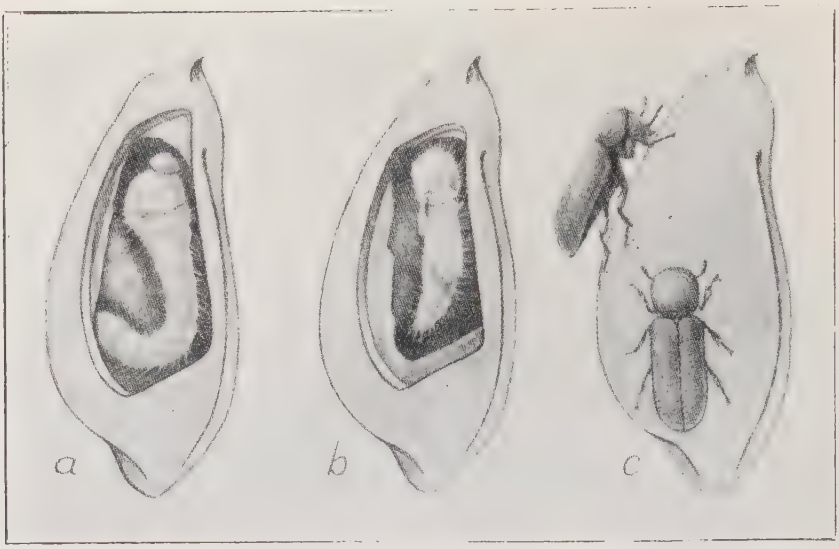

Figure 3.
Life stages of the Lesser Grain Borer. a, Well-grown larva. b, Pupa. c, Two Adults.
[From U.S. Dept. Agri.]

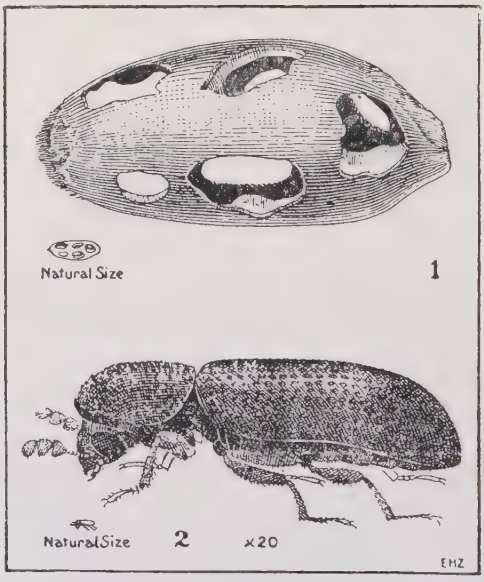

Figure 3a.
1.—Grain of wheat attacked by the Lesser Grain Borer. 2.—The Lesser Grain Borer.
[From Ag. Gaz., N.S.W.]

This pest is now widely distributed in Western Australia, having been first recorded at Fremantle in about 1916. The Geraldton zone was the first country area to be widely affected, but in recent years many other districts have reported the pest.

The Angoumois Grain Moth (*Sitotroga cerealella* Oliv.) (Fig. 4).

The Angoumois grain moth is buff or yellowish brown in colour with a wing spread of about half an inch. It is sometimes found infesting old hay stacks and is parasitised by the hay itch mite (*Pediculoides ventricosus*) which sometimes produces an annoying irritation during the process of chaff cutting.

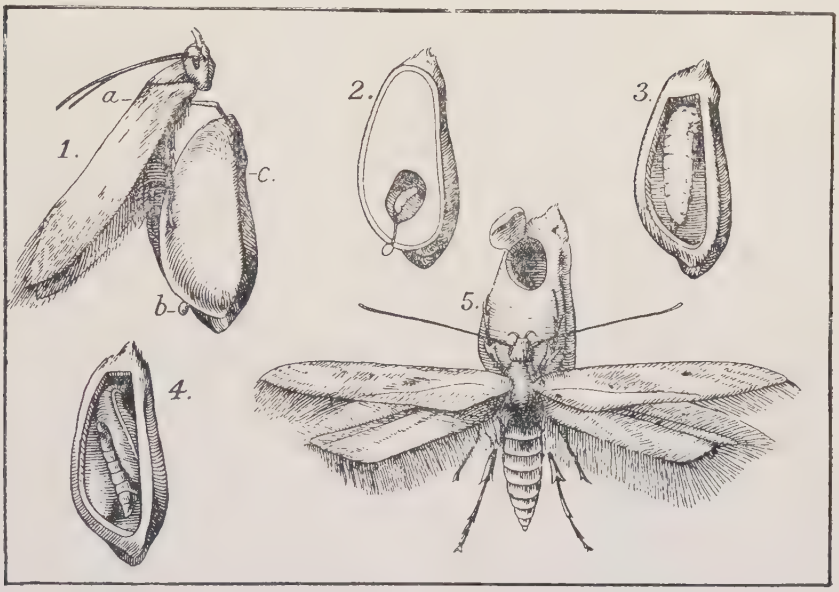

Figure 4.

1.—Adult moth (a), egg (b), wheat grain (c). 2.—Section of wheat grain showing egg and entrance channel of young larva. 3.—Full-grown larva. 4.—Pupa. 5.—Adult moth after leaving by emergence hole as shown.

[From U.S. Dept. Agri.]

Like the rice weevil, this moth is known in some countries to fly into the field to infest the standing grain, but so far no proof of this habit has been received locally, and we can confine our attentions to the insect as a pest in store.

An average of 40 or 50 eggs are laid by the female, but sometimes as many as 250-300 may be deposited. They are laid on or near the grain and the tiny grub on hatching bores into the kernel, often spinning a small cocoon at the entrance. When fully fed it eats out a channel to the seed coat, but leaves a small portion intact which is later pushed off as a lid when, after the pupal stage spent in a silken cocoon within the grain, the adult moth finally emerges. From egg to adult occupies about five weeks but again development is greatly slowed down under cold conditions, although the moth is said to be capable of working at lower temperatures than the weevils.

SECONDARY PESTS.

Confused Flour Beetle (*Tribolium confusum* Jacq. Duv.) (Fig. 5).

The confused flour beetle is a rather elongated shiny reddish brown beetle about one-seventh of an inch in length. The head and thorax are densely pitted and the wing covers ridged lengthwise with punctures sparsely distributed between the ridges.

Like the other storage pests mentioned it is not native to Australia but has been widely distributed by commerce and may be found attacking farinaceous materials in all parts of the world. It is principally a pest in flour mills, being incapable of feeding upon sound grain, but it will attack broken grains and kernels damaged by weevils and consequently helps in the final destruction of stored wheat.

The average life of a beetle is said to be 12 months or more, and females may lay over 400 eggs. These are deposited loosely, and being covered with a sticky secretion become covered with flour or grain dust and readily cling to the sides of bags and other receptacles so that clean material placed in them can rapidly be infested. In five to 12 days the eggs hatch into small grubs about 3/16ths of an inch long and resembling tiny wire worms. These pupate as naked yellowish-white pupæ and about six weeks after the egg was laid the adult beetle emerges. As with the other insects mentioned, this life cycle may be greatly prolonged by adverse conditions.

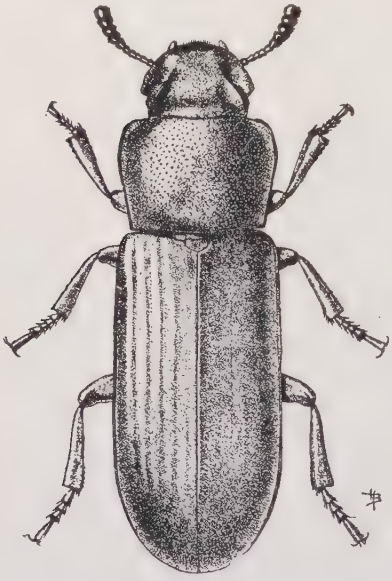

Figure 5.
The Confused Flour Beetle.
[From U.S. Dept. Agri.]

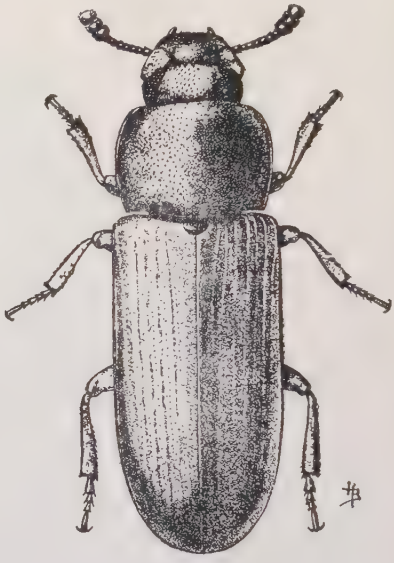

Figure 6.
The Rust Red Flour Beetle.
[From U.S. Dept. Agri.]

Rust-Red Flour Beetle (*T. castaneum* (Herbst)) (Fig. 6).

The rust red flour beetle cannot be distinguished from the foregoing species without a magnifying glass, but whereas the antennæ of the confused flour beetle increase gradually in size towards the tip, those of the rust-red species increase abruptly at the tip, giving them a clubbed appearance. In addition, as can be seen from the accompanying illustrations, the sides of the head of the confused flour beetle are expanded and notched at the eyes whereas in this species the sides of the head are nearly continuous at the eyes.

The habits and life history of this species resemble very closely those of the confused beetle and so need not be further detailed.

The Saw-Toothed Grain Beetle (*Oryzæphilus surinamensis* (L.)) (Fig. 7).

The saw-toothed grain beetle is smaller than the flour beetles and of rather a darker brown colour. It may also be recognised by the six saw-toothed projections on each side of the thorax from which the popular name is derived.

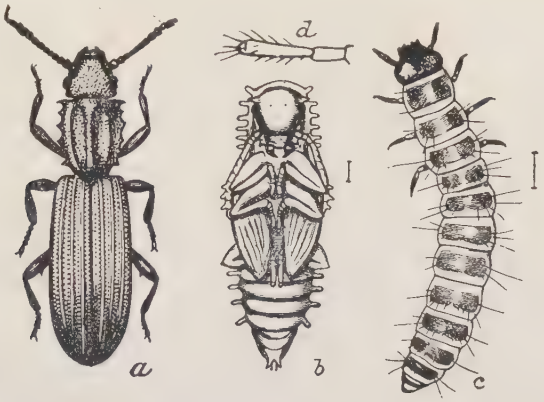

Figure 7.
Saw-toothed Grain Beetle. a, Adult; b, Pupa; c, Larva.
[From U.S. Dept. Agri.]

It is one of the commonest insects found in stored grain in this State, and also attacks many other foodstuffs such as dried fruits, nuts, etc.

The female beetles live from six to 10 months and may lay from 50 to 250 eggs which may be deposited loosely or in the crease of a wheat grain. After three or four days the larvæ appear and two weeks elapse before they spin a thin covering in which to pupate. From egg to adult occupies about four weeks under suitable conditions.

Like the flour beetles, this insect in its adult and larval stage feeds upon flour and damaged grain and assists materially in furthering the damage commenced by the weevils and grain borers.

Flat Grain Beetles (*Læmophlœus* spp.) (Fig. 8).

The flat grain beetles are amongst the smallest of beetles found in stored grain, being only about one-sixteenth of an inch in length. The colour is reddish brown and the antennæ are relatively much longer than in any other beetles mentioned.

The eggs are laid loosely or in grain crevices and the tiny larvæ form gelatinous cocoons, covered with food particles in which to pupate. From egg to adult occupies about eight or nine weeks.

Mill Floss, Flour Bugs, and Bran Bugs.

The beetles described under the heading of "Secondary Insects" are variously known as flour bugs, bran bugs, and mill floss. They are often to be found swarming on bags and in wheat bins and their presence is undesirable, especially in flour mills, but to the farmer or wheat merchant they are not of much conse-

quence and so it is important to be able to distinguish between the primary pests which are able to destroy sound grain and the secondaries which follow in their wake.

This knowledge may save unnecessary anxiety and expenditure in control measures.

Figure 8.
Flat Beetle.
[From U.S. Dept. Agri.]

PREVENTIVE MEASURES.

Moisture Content.

It is generally known that wheat with a high moisture content is more prone to insect attack than that which is very dry, consequently the climatic conditions in Western Australia themselves afford one of the greatest protections to stored grain. Wheat when harvested may contain up to 12 per cent. moisture, but if stored in inland districts the figure may drop in the summer months to as low as eight per cent. or nine per cent. and the scarcity of summer rains favours the safe keeping of the crop. When, as in times of war, grain may have to be stored over one or two winters it is essential to see that no water is allowed to leak in, as damp wheat is one of the most favourable media for the rapid multiplication of weevils.

Much has been written about the figure at which weevil activity ceases on account of the lack of moisture in wheat, and about 10 per cent. is the figure usually quoted. There is much more work to be done on this matter before this can be taken as final, but it is certainly a guide to the degree of liability to attack, and wheat which can be kept in this dry condition is certainly less liable to damage than that with a higher moisture content.

Sanitation.

This is undoubtedly the most important factor in insect control and scrupulous sanitation should be observed right from the harvester box to the bakehouse door. All wheat should be cleared out of the harvester before it is put away and this ensures that when it is taken out next season clean wheat will not be contaminated before it enters the bags.

Second Hand Bags.

The mention of bags brings us to another extremely important point. In districts where bulk installations are present the same bags may be used year after year to cart to the siding. A little grain may be left in the bags when they are put away and this may be sufficient to harbour enough weevils to cause trouble the following year.

When finished with, bags should be turned inside out, thoroughly shaken and brushed, and hung away from any grain. They will then be quite clean and safe when needed later. If there is any reason to suspect that bags have contained weevilly wheat, they should be given special treatment and, if possible, placed in boiling water for five or ten minutes as this will kill all stages of insects that may be present and cause only the slightest shrinkage of the bag.

Store houses and sheds should be thoroughly swept of all old grain and refuse and treated with some suitable insecticide, and new wheat should never be stacked near that of another season. Where possible wheat should be stored on a sound grain-proof floor, so that seed cannot trickle through on to the ground beneath and so be out of reach of the broom.

Conveyances, such as railway trucks and lorries should not be overlooked as sources of trouble, as wheat and insects harboured in cracks and runners can easily be responsible for infesting fresh consignments, or even during their passage about the countryside, bringing contamination to clean storage sites.

To carry out the above instructions may seem irksome and fiddling, but if clean wheat is put into a clean container and no infested material is allowed to contaminate it, there will be no trouble from weevils. Never was the saying "Prevention is better than Cure" more worthy of observation than in the case of combating storage pests, for once a serious outbreak occurs, its control cannot be obtained without great expense, labour and loss.

A few weevils in the bottom of a bag may be enough to infest a whole bin or even a shipment, and so every farmer should strive to see that his carelessness is not the cause of a widespread loss.

Storage Methods.

The bulk storage of grain has much to recommend it for the prevention of insect attack, especially if the bins or silos are of a type that can be readily fumigated or cleaned. On this account steel or concrete bins are desirable, for the walls and floor can be made practically insect-proof and if thoroughly cleaned before being filled, clean wheat can only be contaminated from the top. The infestation will not penetrate to any great distance, as the weevil is said to be unable to penetrate further than about 5 feet, and the Grain Moth could only work in a very superficial layer.

Wooden silos are sometimes bored into by various insects; *e.g.* the Grain Borer, and cracks also offer a suitable harbour from which it is difficult to dislodge pests by any other means than fumigation, hence as little wood work as possible should be employed in constructing grain receptacles, and for farm purposes iron tanks are probably the most satisfactory containers available.

CONTROL.

Probably the most universal control treatment for grain pests is fumigation, but other treatments such as heat and insecticides have their place. Many other methods, including electricity and sifting, have been attempted, but without encouraging results. The latter may free the wheat from adults, but does not deal with the eggs and other stages in the grain; hence reinfestation soon follows.

Fumigation.

For this method to be effective the container to be treated must be more or less gas tight. Carbon bisulphide and hydrocyanic acid gas are the two most common gases used. The latter, being lighter than air, has poor penetrating properties and is more suitable for fumigating containers and mills than quantities of bulk wheat. Temperature is an important factor in fumigation, and a temperature of at least 70° to 75° is desirable for good results, as anything lower tends to reduce the efficiency of many fumigants. The volatilisation of fumigants may be increased either by spraying them into the fumigation chamber or by vaporizing the liquid by the application of heat in an apparatus called a vaporizer.

Carbon Bisulphide.

This gas which is heavier than air is very inflammable and explosive and hence requires considerable care in its use. The method of application is to pour the desired amount of liquid into shallow pans or pieces of sacking and place them on the top of the grain. If the depth of grain is greater than five feet, it is desirable to introduce the fluid by means of a pipe with outlets at suitable distances and in this way the gas which is given off will penetrate to all parts. Moist grain may be injured in its germination properties by this gas, and the baking quality of flour is said to be sometimes injured by the vapours, but this may be prevented by airing the flour before baking.

Carbon bisulphide should be applied at the rate of 1 lb. per 25 bushels of grain, or 4 lbs. per thousand cubic feet of space to be fumigated. The wheat should remain sealed for 48 hours.

Hydrocyanic Acid Gas.

This is chiefly used in this country for fumigating flour mills as the fire hazard is too great when carbon bisulphide is used. Cyanide, however, is very toxic to humans and must be used with great care. The gas may be generated by what is known as the "pot method" or from a number of proprietary preparations.

The standard formula for preparing the gas is as follows—

Sodium cyanide, 1 ounce.

Commercial Sulphuric Acid, 1½ fluid ounces (3 tablespoonfuls).

Water, 2 fluid ounces.

In the case of a mill each storey is treated as a separate unit and made as airtight as possible, but as the gas tends to rise the dosage on the bottom floor should be somewhat increased and the upper ones somewhat decreased. The dosage may be worked out on the basis of 1 lb. of cyanide to 1,000 cubic feet of space for the ground floor.

In preparing the mixture the sulphuric acid should be poured into the water and not vice versa, and the cyanide should be suspended over the earthenware crock, containing the liquid, in a paper bag and lowered in as the door is being closed.

A granular form of cyanide known as Cyanogas G is recommended for mixing with wheat when entering silos at the rate of 1% by weight, and other preparations such as Zyklon B and liquid Hydrocyanic Acid may be used as sources of this fumigant.

Grain or buildings treated with Hydrocyanic Acid Gas should be sealed for at least 12 hours and from 24-36 hours if possible.

Chloropicrin.

This gas is also known as tear gas and has given considerable promise as a fumigant. It is non-inflammable and heavier than air, hence it has the good points of carbon bisulphide without the drawbacks of the latter. It should be applied at the rate of 2 lbs. per 1,000 cubic feet of space in airtight bins, the dosage being increased if leakages are unavoidable.

The gas is said to have a deleterious influence on the baking qualities of flour by retarding yeast activity.

Ethylene Oxide used at the rate of 2 lbs. per 1,000 cubic feet of space for 12 to 24 hours is another well recommended fumigant, but it has a detrimental effect upon the germination of grain required for seed.

Carbon Dioxide.

This gas has proved very effective as an insecticide and was first used extensively during the last World War to control wheat insects in South Australia. Wheat stacks were enclosed in malthoid and carbon dioxide was pumped in in quantities sufficient to maintain the concentration at about 15 per cent. This concentration had to be maintained for at least three days to prove effective. It was later found that if the stacks were made sufficiently airtight, the respiration of the wheat grains plus the weevil activity would generate sufficient carbon dioxide to eventually prove lethal to insect life.

Methyl Bromide.

This is said to be even more toxic to the granary weevil than hydrocyanic acid. It is non-inflammable and hence should have a future as a fumigant. It is only in comparatively recent years, however, that its use has been advocated, and its extreme toxicity to man has militated against its general use.

Sulphur Dioxide.

Although an effective insecticide, sulphur is not very satisfactory as a fumigant, as apart from its tarnishing effect upon metals, it adversely affects the milling properties of flour and the germination of seeds.

Mixed Fumigants.

Different fumigants are mixed with the purpose either of reducing the fire hazard or increasing the toxicity. Carbon tetrachloride or trychlorethylene have been largely used in this direction, but recent investigations have shown that these mixtures are liable to change by fractionation, resulting in unsafe or ineffective fumigants and so the practice of using these substances for compound fumigants is losing favour.

The gas most generally advocated now is carbon dioxide. A 10 per cent. addition to ethylene oxide, for example, reduces the inflammability slightly while the addition of 90 per cent. entirely eliminates the fire risk.

Mixing Fumigants and Grain.

Bulk grain is sometimes treated in this way. During loading or turning a material which will slowly give off the fumigant is introduced in measured quantities. Calcium cyanide which reacts with water vapour and carbon dioxide to give off hydrogen cyanide has already been referred to, but another suitable chemical is ethylene oxide cooled by mixing with solid carbon dioxide. Proprietary prepara-

tions of this mixture have been sold in Europe under the names of "Etox" and "T Gas" and in America as "Carboxide." A third chemical used largely in Germany is magnesium phosphide which generates phosphine by reaction with water vapour.

Loss of Efficiency in Fumigants.

In addition to leakages which were usually considered to constitute the most serious loss, it has been shown that absorption may account for an even greater reduction of the fumigant. The rate of absorption differs with different commodities and is particularly high in the case of flour. Exact determinations of the absorption rate, etc., are important in determining the dosage of a fumigant and the amount of aeration required after treatment to dissipate harmful residues.

General Rules to be Observed when Fumigating.

1. **See that the container is as airtight as possible.**
2. **Do not fumigate wet or immature grain if it is desired for seed purposes.**
3. **Air foodstuffs or buildings as much as possible after treatment.**
4. **Take all necessary precautions with inflammable or highly toxic fumigants.**

Insecticides.

The insecticides which can be recommended for use against grain pests are limited, as their residue must not be toxic to humans or such as to taint the flour or wheat.

Sprays.

Kerosene-pyrethrum sprays, such as the many commercial fly sprays, are effective and may be used in empty bins, etc., where a little airing is possible before the grain is received.

White Oil.

White oil was primarily prepared for use against insect pests on fruit trees, but it has been shown to be very effective in killing weevils and also rendering grain treated with it relatively immune to attack.

Wheat dipped in white oil and water 1 part to 10 was not attacked by weevils under laboratory conditions, and a high percentage of mortality resulted when this oil was used as a spray at 1 to 30.

Dusts.

Much research has been conducted recently into the use of so-called "insect" dusts for the control of grain pests. One of the first to gain recognition and to be tested extensively for several years in Germany and Russia was a proprietary silica dust known as "Naaki" dust. The fine grains of silica adhere intimately to the insect and are believed to cause death either by mechanical action or by their dessicating properties or by a combination of both. Various forms of powdered silica have since been experimented with as well as types of colloidal clays such as bentonite.

In the use of these dusts it is usually recommended that the bins be thoroughly treated at the rate of about 1 lb. to 80 square yards of surface and that the powder be mixed with the wheat at the rate of 1%.

Much research is still necessary into the use of these dusts and other insecticides, and these avenues are at present receiving considerable attention from research workers.

Heat Treatment.

Heat treatment is one of the most effective ways of dealing with insect pests in wheat. It has been shown that at a temperature of 120° F. maintained for 3 hours will kill all stages of weevils, while 130° F. for 30 minutes is also effective.

Higher temperatures are more rapidly effective, but anything above 145-150° F. may be detrimental to the wheat. It is, of course, essential that the whole bulk of wheat be raised and maintained at the temperature cited.

Sifting.

Winnowing wheat is often suggested as a control for weevils, but it is little more than a palliative. The light grains and adult insects may be sifted out or blown away, but the grains containing eggs and larvae still remain, so that although the resulting sample may appear to be weevil-free, unless it is used immediately it will again give rise to a crop of beetles.

Pickling.

The pickling of wheat for the control of fungus diseases has been found to also constitute a very effective safeguard against "weevils." Copper carbonate dust used at 2 ounces to the bushel and the various mercurial pickling agents have proved effective insecticides. This method of control is, of course, only practical for seed wheat, as pickled wheat is not suitable for milling or for stock.

SUMMARY.

Primary insects are those capable of injuring sound grains—

1. Rice Weevil.
2. Grain Weevil.
3. Lesser Grain Borer.
4. Grain Moth.

Secondary insects infest grain already damaged or attacked by primary pests—

1. Flour Beetles.
2. Saw Toothed Grain Beetle.
3. Flat Beetles.

Prevent infestation by—

1. Cleaning out bins, trucks, bags, etc., thoroughly before putting in fresh wheat.
2. Hanging bags over a wire when not in use instead of piling them on the floor.
3. Fumigating, spraying or giving heat treatment to bins, trucks or other receptacles which have contained weevily wheat.
4. Keeping wheat under dry conditions.
5. Never storing new season's wheat near that of a previous season.
6. Never mixing old and new season's wheat.

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The Control of Wild Turnip (*Brassica Tournefortii*) *in* the Wheat Crop by the use of Copper Sulphate and Sulphuric Acid Sprays.

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Introduction.

The occurrence of the weed in Australia is mainly confined to Western Australia, although during the last few years it has been recorded in other States, where it is also causing concern. It is believed by some that this plant was first introduced into this State, about 1916, from Mediterranean countries, such as Palestine, Egypt or Tripoli, where it is common.

Although this weed probably made little progress in the first few years following its introduction, it is now apparent that by 1927 or 1928 it had become firmly established in parts of the Kellerberrin and Merredin districts. In 1929 it was officially identified and its seriousness realised, and was immediately gazetted a noxious weed for the whole State.

Despite the precautions taken and the warnings issued, it quickly spread throughout the main wheatbelt, where conditions were highly suited to its growth, until now it occurs to a greater or lesser extent in all districts from Ajana in the north to Salmon Gums in the south. In the wetter and more westerly districts it does occur, but so far has not reached the serious proportions or caused the same difficulties or losses in cropping, that it does in the more easterly wheatbelt districts.

This plant has been fully described by the Government Botanist (Mr. C. A. Gardner) in the Journal of the Department of Agriculture, W.A., Vol. X, September, 1933, pp. 409-419. In the same article, cultural methods of control were dealt with very fully by Mr. G. L. Throssell, Agricultural Adviser. Such methods have been successfully adopted by many farmers, but in many cases they have been only partially effective owing mainly to the manner in which the mature plant breaks off at the base and readily rolls along in the wind for miles, dropping seed as it travels. This is probably the worst feature of this weed where the usual cultural methods of control are carried out. Good fallowing methods and cultivation will not prevent reinfection of the land from badly infested areas considerable distances away. This difficulty is accentuated in years when the opening rains are late and farmers are forced to sow on a dry seed bed without a germination of weed seeds having occurred which would enable the young plants to be killed by cultivation before the crop is sown.

The following information made available by the C.S.I.R. (A.B. Cashmore 1936 unpublished) is pertinent to the question of variable germination frequently recorded under field conditions.

To discover the conditions favouring germination in *Brassica Tournefortii*. a germination test was undertaken. The treatments employed included incubation at four temperatures—20°C, 25°C, 28°C, 35°C— and treatment with concentrated

sulphuric acid for five and 10 minutes with subsequent incubation at 25°C. Laboratory temperatures sometimes exceeded 20°C so that seeds in the lowest temperature incubator were subject to slightly fluctuating temperatures. Germination was carried out in moist sand in Petri dishes. The results are presented in the following table:—

Treatment.	% Germination in—						
	3 days.	4 days.	5 days.	6 days.	7 days.	10 days.	21 days.
20° C.	9·25	13·25	13·50	13·75	...	...	14·00
25°	0·75	1·50	1·75	...	...	2·00	2·25
28°	...	0·50	1·00	...	1·25	...	1·50
35°	...	...	0·25	...	...	...	0·25
25°—Acid 5 mins. ...	26·66	40·00	46·00	47·33	50·00	52·66	58·00
25°—Acid 10 mins. ...	53·33	59·33	62·00	65·33	...	...	66·00

In the temperature treatments four replications of 100 seeds each were used; in the acid treatments 50 seeds were sown per dish and germinated in triplicate.

The results indicate that *Brassica Tournefortii* requires relatively low temperatures for germination and that the sample of seed tested, from Nangeenan, Western Australia, contains a high proportion of hard seed. This characteristic, ensuring discontinuous germination, possibly accounts for the persistence of the species in the wheat districts of Western Australia.

Spraying Experiments, 1937-1939.

In view of reduced yields and the difficulties experienced during harvesting operations and the failure in many cases to control the weed by ordinary cultural methods, it was decided in 1936 to commence experiments in association with the C.S.I.R. to test the efficiency and economics of controlling this weed by means of various chemical sprays.

1937 *Experiments.*

A suitable site was chosen on Mr. M. V. Cahill's property at Nangeenan, in the Merredin district, and sown with the wheat variety "Totadgin" at the rate of 45 lb. per acre and superphosphate at 120 lb. per acre on May 13th. It was anticipated that there would be a good growth of wild turnip on the area selected, but to ensure this, seed of this plant was mixed with the superphosphate and sown at approximately 4 lbs. per acre. On June 30th the plots for the following treatments in the form of a 6 x 6 Latin square were laid out on the area—

Unsprayed control.
Sprayed 3% sulphuric acid.
Sprayed 3% sulphuric acid, plus agral.
Sprayed 5% sulphuric acid.
Sprayed 7½% sulphuric acid.
Sprayed 3% copper sulphate.

The spray treatments were applied at 100 gallons per acre by knapsack sprays on July 1st and 2nd. Conditions throughout the Eastern Wheatbelt amounted to practically a drought during 1937, and consequently from the point of obtaining grain yields, the experiment was a failure. However, on October 1st,

counts were made of the turnip plants in all plots by taking at random ten sections each four links square in each plot. The results are tabulated hereunder:—

Table 1.

Spray Treatment.	Counts.	
	No. of Turnip Plants per square link.	Percentage.
Nil	3·9	100
3% Sulphuric Acid	3·7	95
3% Sulphuric Acid and Agral ...	3·6	92
5% Sulphuric Acid	1·9	49
7½% Sulphuric Acid	1·0	26
3% Copper Sulphate	1·1	28

These results show that only the 5% sulphuric acid, 7½% sulphuric acid and 3% copper sulphate have had any significant effect on the wild turnip. The 7½% sulphuric acid and the copper sulphate were more effective than the 5% sulphuric acid.

1938 *Experiments.*

The experiment was again conducted on Mr. M. V. Cahill's property at Nangeenan. The procedure was similar to that adopted in 1937, except that the very early maturing wheat variety "Noongaar" was sown and the rate of wild turnip seed increased from 4 to 7 lb. per acre. The spray treatments tested in addition to the unsprayed controls, were 2% copper sulphate, 3% copper sulphate, 5% sulphuric acid and 7½% sulphuric acid. The experiment was laid out in the form of a randomised block with five replications. Again, however, as in 1937, seasonal rains were extremely light, so much so that by the middle of September crop growth was very poor and all the wild turnip and other weed in the control plots had dried off. Hence the experiment from the point of view of determining the effect of the various spray treatments on the control of wild turnip was practically valueless. The plots were harvested, however, to ascertain the effect of the various sprays upon the resultant grain yield.

The yields obtained are set out in Table 2 hereunder:—

Spray treatment	Average Yield per acre.	
	Bushels.	Lb.
Control	8	54
2% copper sulphate	8	54
3% copper sulphate	8	6
5% sulphuric acid	7	38
7½% sulphuric acid	7	33

The yields are very low and reflect the poor seasonal conditions experienced. It would appear from the results that the sulphuric acid and 3% copper sulphate treatments have had a slightly depressing effect on the resultant crop yield. It

must be remembered, however, that these plots received a definite check when sprayed which was not followed by any good rain to assist their recovery.

1939 *Experiments.*

In view of the inconclusive results which had been obtained at Nangeenan owing to the adverse seasonal conditions, it was decided that in addition to the experiment at that centre, further sites would be selected in other districts, so that in the event of similar conditions prevailing at Nangeenan, as in the past two seasons, it would be possible to transfer the spraying experiments to areas where conditions were more favourable. This provision was indeed fortunate as very poor germination of wild turnip was obtained on the site selected at Nangeenan.

Two other sites were therefore selected, one on Mr. R. Clausen's property at Kununoppin, and the other on Mr. P. C. Paterson's at North Baandee, and arrangements made for conducting the experiment in duplicate. At each centre the following treatments were laid out in the form of a randomised block with seven replications, giving 35 plots each 64 yards x 4 yards:—

Unsprayed—control.
Sprayed—2% copper sulphate.
Sprayed—3% copper sulphate.
Sprayed—5% sulphuric acid.
Sprayed—7½% sulphuric acid.

At North Baandee the land was a red loam which had previously carried salmon gum (*Eucalyptus salmonophloia*) with a slight mixture of gimlet (*Eucalyptus salubris*). It was fallowed in July, 1938, with a rigid tyne cultivator, spring tyned in March, 1939, and seeded with a combined cultivator drill about mid May with the variety "Gluclub" at 47 lb. per acre and superphosphate at 90 lb. per acre.

The soil on the Kununoppin experimental area was a sandy type, originally timbered with sandy salmon gum (*Eucalyptus leptophylla*) and mallee (*Eucalyptus* spp.). It was cultivated with a spring tyned implement about the middle of May and seeded at the end of that month with a combined cultivator drill with the very early variety "Noongaar" at 55 lb. per acre, and superphosphate at 80 lb. per acre.

Spraying.

At North Baandee the wheat was further advanced than was desirable for the experiment. There was a good quantity of turnip present in various stages of growth, from the 4-5 leaf stage down to newly germinated plants with occasional large plants up to two to three inches in diameter. The crop had stooled well and appeared to be getting away from the weed. It was doubtful if the wild turnip would have had any very adverse effect on the wheat crop. Spraying was carried out on July 12th and 13th. Both days were very sunny and all plots were sprayed in bright sunlight. No rain fell during the night, but there was a heavy dew.

At Kununoppin, both wheat and wild turnip were in the stage of growth desired for the experiment. The wild turnip was very plentiful and was expected to have a very adverse effect on the wheat yield. Spraying was carried out on July 17th. The day was cloudy and none of the plots was exposed to bright sunlight until the following morning. No rain fell either during the day or night and there was practically no dew.

Observations After Spraying and During Growth.

In both experiments the effect of the 7½% sulphuric acid was evident very shortly after sprayings, both the wheat crop and the wild turnip showing signs of burning. On the day following spraying all plots sprayed with sulphuric acid showed evidence of burning. The wild turnip appeared to be dead and the upper leaves of the wheat plants badly dried. The crop in the plots sprayed with 7½% sulphuric acid were appreciably more affected than that in those sprayed with 5% acid. No visible difference was apparent between the plots sprayed with copper sulphate and the control plots.

In early August an examination of the experimental sites indicated that both acid treatments had exercised considerable control of the wild turnip, but also had adversely affected the crop growth. In the copper sulphate plots some effect could be seen both on the wild turnip and the crop, but in all cases it was mild and a satisfactory control of the weed was certainly not indicated.

Results.

During August, ten 1 square link counts of both wild turnip and wheat plants were made in each plot. These determinations are given in Table 3 hereunder:—

TABLE 3.

Table showing the mean number of plants per square link, together with these expressed as a percentage of the control plot.

Counts made on 7th August, 1939.

Location of Experimental Site.	——	Treatments. Control.	2% Copper Sulphate.	3% Copper Sulphate.	5% Sulphuric Acid.	7½% Sulphuric Acid.	Difference necessary for Significance. (P = ·05)
R. Clausen, Kununoppin	Wild Turnip	8·97	2·88	1·84	0·73	0·30	0·93
	(Percentage)	100	32	20	8	3	10·4
	Wheat	3·76	4·63	4·74	4·64	3·77	Not significant
	(Percentage)	100	123	126	124	100	Not significant
P. C. Paterson, North Baandee	Wild Turnip	8·07	3·36	1·34	1·40	*Nil*	1·77
	(Percentage)	100	41	17	17	*Nil*	21·9
	Wheat	4·10	3·77	3·57	3·66	3·09	Not significant
	(Percentage)	100	92	87	90	75	Not significant

Before harvest all plots were reduced to 60 yards in length. A six-foot strip down the centre of each plot was harvested and the weight of grain obtained from that area was recorded. The harvest results are given in Table 4 hereunder:—

TABLE 4.

Wheat Yield Results expressed as bushels per acre.

Location of Experimental Site.	Treatments. Control.	2% Copper Sulphate.	3% Copper Sulphate.	5% Sulphuric Acid.	7½% Sulphuric Acid.	Difference necessary for Significance. (P = ·05)
R. Clausen, Kununoppin (Harvested 21st December, 1939)	8·98	10·18	9·61	9·77	9·63	Not significant
P. C. Paterson, North Baandee (Harvested 18th December, 1939)	26·62	24·08	25·38	24·67	24·84	0·85

Discussion.

It is evident from Table 3 that all spray treatments significantly reduced the density of the wild turnip population, and further, the sulphuric acid sprays have been more effective than the copper sulphate sprays. At Kununoppin the 5% sulphuric acid destroyed 92% of the turnip, and the 7½% acid 97%, while at North Baandee the figures for the two treatments are 83% and 100%, respectively.

In the case of copper sulphate sprays, the 2% treatment at Kununoppin destroyed 68% of the turnip, and the 3% spray 80%, whilst at Baandee, the figures were 59% and 83%, respectively. At Nangeenan in 1937, 7½% sulphuric acid destroyed 74% of the turnip, and the 5% 51%, whilst the 3% copper sulphate spray was equally effective as the 7½% sulphuric acid spray. Considering the results of the three experiments together, Nangeenan (1937), Baandee (1939), and Kununoppin (1939), it can be concluded that the control exercised by the copper sulphate sprays used were only partially effective when compared with sulphuric acid.

None of the spray treatments had any effect on the number of wheat plants present. However, observations made immediately following the time of spraying showed that all the sulphuric acid sprays had caused injury to the wheat plants. Inspections later in season showed that whilst these had recovered from the initial injury, they were still backward when compared with the plants in the control plots.

Reference to Table 4 shows that at Kununoppin the spray treatments had no significant effect on the wheat yields. The plots were located on unfallowed land. At the time of spraying wild turnip was present in a dense stand and the wheat plants were four to five inches high. If from the counts made in August, it can be assumed that the turnip was present in such quantities as to reduce the wheat yield, then it can be concluded that any advantage gained by the reduction in the turnip population resulting from the sprays must have been offset by the injury to the wheat plants caused by those sprays.

In the case of the North Baandee experiment, the sprayed plots yielded significantly lower than the unsprayed ones. The soil was of good quality and had been well fallowed, and although the turnip was plentiful (eight plants per square link), the crop was well advanced and at the time of spraying it did not appear as though the turnip would have any effect on the resultant crop yield. This observation is substantiated by the yield of 26½ bushels from the control plots.

In the experiments described, the destruction of the wild turnip by the various sprays has not led to increased crop yields, owing to the injury caused to the wheat by these sprays. From one year's operations, this process must be considered uneconomical. However, it might be argued that the benefits and advantages to be obtained from practically a total destruction of the wild turnip by spraying in one year could only be assessed from the results over a number of years. This would imply that in subsequent years the wild turnip on these areas would be much lower than if it had not been sprayed, and control by the usual cultural operations would be reasonably effective and satisfactory. The amount which germinates in any year, the percentage of hard seeds and also the amount of reinfestation by blowing from other paddocks would have an important bearing on this point.

Bearing in mind all these aspects, it is considered that the use of sulphuric acid sprays are unlikely to offer an economical method of control of wild turnip under Western Australian wheatbelt conditions, except possibly on isolated badly infested areas which may be a menace to adjoining clean areas.

Summary.

The results of three years' (1937-1939) experiments with the use of copper sulphate and sulphuric acid sprays for the control of wild turnip (Brassica Tournefortii) in the wheat crop are presented.

These experiments have shown that 83 to 100% of the turnip can be killed by the use of sulphuric acid sprays at the strength of 5% and 7½% applied at the rate of 100 gallons per acre. A higher level of control has apparently been obtained by the stronger spray, but from the practical and economic aspect it must be considered that the 5% solution is highly effective.

Copper sulphate sprays at the strength of 2% and 3% have appreciably reduced the number of turnip plants, but these sprays must be considered only partially successful when compared with the sulphuric acid sprays.

None of the sprays tested have had any significant effect on the actual number of wheat plants, but they have caused injury to the plants. The grain yields from the sprayed plots were not appreciably higher than those of the unsprayed controls. This suggests that the injury to the wheat plants was severe enough to offset any advantage which may have resulted from the destruction of the weed.

Experiments conducted by Mr. A. B. Cashmore of the C.S.I.R. regarding the effect of temperature and acid treatment on the germination of wild turnip seed are recorded.

The economic and practical aspects regarding the control of wild turnip by spraying are discussed.

Acknowledgments.

As mentioned in the introduction, this investigation was a joint one conducted by the Department of Agriculture and the Division of Plant Industry of the Council for Scientific and Industrial Research who supplied the necessary material for the experiments. The Chief of the Division, Dr. B. T. Dickson, and his Officers were responsible for the original plans and at all times offered material assistance with advice and criticism. Our thanks are also due to Messrs. Cahill, Paterson and Clausen who readily made their land available for the experiments.

The Cultivation of Flax for Fibre.

H. G. Elliott, Agrostologist.

Introduction.

In June, 1940, the Minister for Agriculture (Hon. F. J. S. Wise) was asked by the Commonwealth Department of Supply and Development if this State would be able to assist and co-operate in the production of wax for fibre. The reason for this request can be given by examining the effect of the War on the availability of supplies of flax fibre both in Australia, and in the United Kingdom. World production of flax fibre in 1937-38 was 806,000 tons, of which more than 700,000 tons were produced in Soviet Russia, and only 8,000 tons (1% of the total) in the British Empire. This dependency on foreign source of supply made itself felt in two stages, each of which has been met by appropriate action by the Commonwealth Government. In the earlier months of the War supplies from Russia and the Baltic Ports generally were severely restricted, resulting in a short supply in

Australia for essential requirements such as covers for railway trucks, fire hoses, water bag canvas, linen thread or flax yarn, as well as a wide range of flax products demanded for the equipment of the fighting forces.

The Department of Supply and Development took prompt measures to meet this shortage by encouraging producers in Victoria to raise the area of 2,000 acres at the time under cultivation to an area of approximately 8,000 acres, in districts considered most suitable for production. Following on this, a new and more serious restriction was brought about by the over-running of the countries of Western Europe by the Nazi forces, involving the loss to Great Britain of Belgian and Dutch supplies. The United Kingdom Government immediately forwarded an urgent request to Australia that assistance should be given to make up this deficiency, and in addition to an offer to purchase as much as would be available of the production of the 8,000 acres then being planted, Britain asked the Commonwealth to plant an additional 400 tons of flax seed which was available in London, and offered to purchase the resultant crop from the 13,000 additional acres as fibre.

With regard to the 8,000 acres which were sown for local consumption, the Department of Supply and Development has entered into contracts to purchase the flax fibre of approved quality from any processor able to supply it, and will arrange for the sale of the fibre to spinners who will supply the Australian market for yarn. For the current year the price paid to the farmer for his flax straw will be the same as was paid last year, namely £5 per ton for straw of suitable quality, which from experience is a payable price. In fixing the price of the straw at this level when overseas quotations for fibre have mounted above those ruling before the outbreak of the war, the Government had in view the desirability of avoiding price booms with the consequent danger of price slumps. It was intended to avoid unfair discrimination between farmers who would otherwise be able to reap a good war-time profit and those not so fortunately placed. Having decided against profiteering in all forms, the Government saw no reason to allow temporary exploitation of the flax market to take place to the detriment of the community and against the permanent interests of the industry.

Area Selected.

Following on this application for the development of the industry in Western Australia, our Department believed that an opportunity existed for the development of the flax growing industry. The area selected this year for the production of flax was that extending from Waroona to Dardanup. The principal reason for selecting this area was knowing the seed would not arrive from England until the beginning of August, it was considered advisable to utilise, where possible, irrigation land for the production of flax during this season.

To get the necessary good and ready response the new flax farmers would need to be guaranteed some minimum return for undertaking production, provided they complied with instructions regarding preparation of land, sowing, harvesting, etc., given by responsible officers of the Department of Agriculture. In making this appeal to farmers to co-operate in this patriotic war effort, the Commonwealth Government has made it clear that to sow in unsuitable districts would be only to waste precious seed, time and opportunity, and would in fact hamper rather than help the nation's war effort. Within the districts selected, the following conditions have been laid down:—

(1) that seed shall be made available by the department to farmers at 15s. per bushel plus rail freight from the port of arrival, the cost of the seed to be deducted from the farmer's crop cheque when settlement is being effected.

(2) that the Commonwealth agrees to purchase the whole of the resultant crop from the farmer on a basis of £5 per ton standard quality, and reserves the right to discount any crop which does not come up to the standard quality requirements, and pay premiums up to £1 per ton on better quality straw.

(3) that provided the farmer performs all necessary cultural operations to the satisfaction of the State Department of Agriculture, he will be guaranteed a gross return of £4 10s. per acre, this guarantee to be subject to reduction in respect of any operations not performed.

Advisory Committee.

The Commonwealth has already appointed an Advisory Committee to assist in the production of flax, comprising:—

Mr. J. A. W. Stevenson, Department of Supply and Development, Chairman.

A representative of the Council for Scientific and Industrial Research.

A representative of the Department of Agriculture in each State where this scheme is operating, and

Messrs. R. B. Hogg and E. H. Kinnear, Jun., representing the processors.

The State Departments of Agriculture will provide the machinery for controlling the sowing and cultivation of the crop, and will be assisted by local committees appointed by the Commonwealth Government in areas selected as suitable. The Department of Supply and Development, through the Advisory Committee, has taken steps for the local manufacture of fresh equipment and the establishment of mills for processing the increased crop which has been contemplated.

Flax.

There is a great deal of confusion in the minds of people as to what flax is, and what it looks like. True flax (*Linum usitatissimum*) is often confused with New Zealand flax, a coarse fibred plant (*Phormium tenax*), entirely different from flax and not comparable to it in value. Phormium fibre is a relatively cheap product and is used in goods like binder twine. Unfortunately, the term "flax" is a misnomer. Hemp has a fibre that is actually stronger than flax, and competes with it to some extent in industry, and like flax is regarded as a soft fibre, while Phormium is a hard fibre, extracted by mechanical decortication. In contrast, the fibre of flax is normally extracted from the rest of the tissue forming the stem by taking advantage of bacterial action which occurs under favourable conditions of temperature and moisture, or by a new process of economical retting which has been developed by the Council for Scientific and Industrial Research.

Flax was probably first grown in Western Australia in the years 1905-6 at Narrogin and Brunswick Junction. Very little work was done following the initial stages of growing of this plant until 1918, when another small scale experiment was carried out in the Katanning, Narrogin, Brunswick, Merredin and Chapman areas. The results of these experiments were not encouraging at the time, this probably being due to not selecting suitable areas and suitable strains of flax seed. Further experiments have been carried out from time to time in this State, and during the year 1939 an experiment was conducted at the Denmark Research Station with a number of varieties to determine if any variations occurred under these conditions. The variety known as Liral Crown which is extensively grown

to-day in Victoria gave the best results from the point of view of length of fibre. Straw with a length of up to 3ft. 9in. was obtained. Further experiments are being conducted this year at Denmark, and also at Manjimup. These experiments were initiated prior to any information being obtained that it would be necessary for us to grow a much larger area for Commonwealth needs.

Climatic Conditions.

The average annual rainfall should be in the vicinity of 30-38 ins. Cool moist spring, together with good finishing off rains at the end of the growing period are essential for best fibre production.

Soil.

It is recommended that the best soil is one which can be considered a medium loam overlying clay, being reasonably fertile, moist and well drained. Rich soils have a tendency to cause the crop to grow coarsely with a liability to lodge. Excessively dirty land should be avoided on account of weeds, more particularly such tall-growing weeds as radish, docks, wild oats, etc.

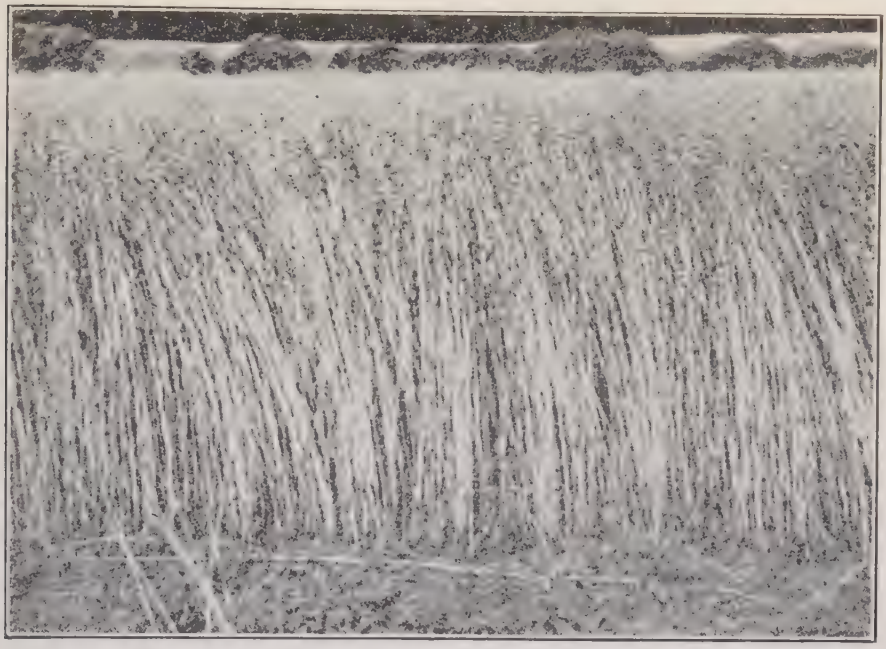
Rotation.

Flax should not be grown on the same ground more often than once in five years, as otherwise the land tends to become flax-sick, due to the accumulation of a fungus disease (*Fusarium lini*), which causes flax wilt. The flax, therefore, should be used in rotation with other crops, such as potatoes, peas, etc., or the paddock left out in pasture. It has been stated that flax is a soil robber, but in recent years this has been authoritatively contradicted. The theory of fertility depletion appears to have arisen in cases where flax was grown for several years in succession on the same land, poorer crops being recorded each year. This decrease in yield has been found to be due to the increasing incident of the abovementioned flax wilt in the soil, rather than to fertility depletion. As flax does not cover the ground in its early stages, it will not suppress any strong growing weeds such as those mentioned. Care, therefore, should be taken in selecting clean ground for flax, as weeds cut with the crop reduce its market value.

Diseases of Flax.

Linseed or linen flax is subject to a number of diseases, the most serious being the fungus disease *Fusarium lini*, known as flax wilt. Generally speaking, this is the most serious menace to the successful cultivation of linen flax. Infected plants simply wilt and die at any stage of growth. Seed harvested from an infected crop carries the disease fungus which enters the soil in which the seed is sown. There it can remain, and it is capable of infecting a crop planted in this soil after 11 years. If both seed and soil are free from the disease, there is little prospect of infection from either source. Another disease which causes quite a considerable amount of damage is flax rust (*Melampsora lini*) which forms bright orange or shiny black patches on the leaves and the stems. When it attacks the stem, it greatly reduces both yield and quality of the fibre. As the spores or reproducing bodies of the fungus are carried in large numbers by the wind, rust is difficult to control, but trials which have been carried out in other parts of the world have indicated that in a normal season the majority of crops are little affected. Stem breaking or browning is another fungus disease which attacks the plant through the cotyledons. The stem collapses close to soil level. This fungus is also responsible for the blight of leaves,

stems and bolls which appears shortly before harvesting. To this phase of the disease the name of browning is applied. Browning substantially lowers the quality of seed and fibre. In this State very little trouble should occur from these diseases as only a very small amount of linseed or linen flax has been grown previously. Also, the seed which has been used this season should have been relatively free from any of the above mentioned diseases. To assist in controlling any disease all the seed before it was forwarded to the farmers, was treated efficiently with Cerosan New.



An excellent crop of Linen Flax grown in New Zealand.
[Block by courtesy New Zealand Journal of Agriculture.]

Insect Pests.

The pests likely to prove a menace to flax production, are the red legged earth mite and cutworms.

The mite damages the crop in the early stages and causes a severe set-back and in some cases death of the plants. The best control is the preventive measure of clean fallowing for as long as possible before planting the crop.

Cutworms are controlled by the same cultural methods. The climbing cutworms, which attack the plants in the seed heads, are the most serious.

Further information on the control of these pests is contained in leaflets available at the Department of Agriculture.

Strains.

Much work has been carried out in Victoria to determine the most suitable strains for the production of linen flax in Australia. Up to date the strain most successfully used is the one known as Liral Crown, which gives high yields

of satisfactory straw. This strain is a relatively late maturing one. The Liral strains were developed by the Linen Institute Research Association in North Ireland. Other strains known as Stormont strains were developed by the Government in North Ireland, as superior strains of fibre flax. We have for instance, the Liral Monarch, Liral Dominion, Stormont Cirrus and Stormont Gossamer, these being all relatively new strains. The Blue Riga is one which has been grown in Australia for many years. The seed which has been sown this year in Western Australia is known as the Concurrent White Flowering Dutch strain, which is a late maturing one. There are many strains, ranging from early to late maturing groups.

Ploughing with mould-board plough on typical flax country, Gippsland.
[Block by courtesy Victorian Journal of Agriculture.]

Cultivation.

Owing to the seed being small, well worked, compact, fine seed-beds, free from weeds are necessary prior to planting. It is recommended that the land be ploughed to a depth of four to five inches with a good mould-board plough, which turns the sod completely over as shown in the accompanying block. The land should then be worked down with harrows and cultivators; if possible, rolling to compact the soil would be advisable to enable a fine, smooth seed-bed to be prepared for seeding operations. Prior to planting, it may be necessary to carry out further surface cultivation to control any weeds which may have appeared. It is usually recommended to have the land in fallow for a period of at least four weeks prior to seeding. This would also assist in controlling the red legged earth mite which attacks the young seedlings.

Rate of Seeding.

Experiments carried out in Victoria indicate that 50 lbs. per acre of seed is rather light, but that heavier sowings than 70 lbs. per acre are hardly necessary. In any case, where soil conditions are such that a good germination can be expected, sowing more than 70 lbs. per acre may be attended by the risk of crop lodging.

Time of Sowing.

Time of sowing trials carried out in Victoria have shown very interesting results. There is a general reduction in yield from the May to the September plantings, and very late sowings give extremely light yields. It is recommended for normal years that, under our conditions, May to June planting would be the most successful. Although late planting has been carried out this year, provision has been made for the bulk of the areas to receive irrigation water, if necessary, at the latter end of the growing season.

Block showing patchy germination of flax due to deep sowing and dry weather.

[Block by courtesy Victorian Journal of Agriculture.]

Method of Sowing.

The seed can be either drilled or broadcast. If drilled, Victorian results have shown that the best width between the drills is 3½ inches, but seven inches can be used with success. Generally speaking, drilling is preferred, but the seed can be mixed with the superphosphate just prior to sowing and broadcast or sown through a top-dresser. If drilling is carried out, the fine side of the grain box feed is used, but as drills vary considerably in their rate of sowing for the same seeding, the farmer is advised to test his machine thoroughly before commencing to seed. Shallow drilling is essential. On no account should seed be placed deeper than one inch. The tubes can be left in the hose or removed and the seed allowed to fall direct on the ground, to give the effect of broadcasting. Very light harrows should follow. The use of the roller prior to seeding will assist in securing shallow sowing, and also leave the land comparatively level for low cutting at harvest.

Fertiliser.

In Western Australia it is considered that the only fertiliser required would be superphosphate applied at the rate of approximately two cwts. per acre. Where, however, last year's potato land is being used, an application of not less than 1½ cwts. would be suitable. It has been found in Victoria, that on any rich soils where strong growth can be expected, it would be wise to reduce the rate of application even lower than that recommended, especially if the seed has been sown early. It is better to have a two-ton crop of standing flax than a 2½-ton crop lodged. Where late sowings on rich land have been carried out, the rate of dressing of superphosphate should be increased. In Victoria muriate of potash and sulphate of ammonia combined with superphosphate have been tried over the last three years without sufficient success to warrant or recommend their use. Following the sowing of the seed no other treatment is required during the growing period except to remove tall growing weeds such as thistles, docks, etc. This should be undertaken when the crop is four to six inches high. Once flax is two to three inches high it is not affected by heavy frosts.

Harvesting.

European harvesting practice consists of pulling the flax crop by hand or machine, this operation costing approximately £2 per acre. By this method the sheaves can be made up free from all weed, and lodged crops can be handled efficiently. The Australian practice to date has been to use the ordinary crop binder which does the work much more cheaply. However, it cannot avoid the

A 3½-ton crop of flax in the stook at Strathkellar, Victoria.
[Block by courtesy Victorian Journal of Agriculture.]

inclusion of tall weeds or make good sheaves from a lodged crop. This disadvantage does not assume serious proportions in normal crops. Flax is tough and offers considerable resistance to binder knives, consequently plain knife blades should be used and they should be kept thoroughly sharp. The seed heads are prone to become tangled, and difficulty is often experienced in separating the cut from the uncut straw unless a special divider is attached to the machine. The sheaves should be well butted and tied somewhat closer to the head than

the butt. It is recognised that flax is ready for harvesting when the stem has turned yellow from half to one-third the way up, and the bulk of the small stem leaves have dropped to the ground. If no moisture can be squeezed out of the bolls or seed heads, harvesting can then be started. The most advanced seed heads will probably contain ripe seed while that in the greenest bolls will be slightly milky. However, it will mature considerably in the stook, and should be ripe when the straw is carted. The sheaves should be built into long narrow stooks. Ten days there without rain is usually sufficient to complete ripening, and the straw should then be forwarded without delay to the mill.

Flax Mill.

It is usually considered that the requirements for a flax mill would be a minimum of 1,000 acres and a maximum of approximately 1,500 acres. It is also necessary to have the areas in which the flax is growing located in close proximity to the millsite. A radius of 20 miles would be the limit. The Commonwealth Supply Department proposes to erect and equip a mill capable of handling the material from the area which is under production this year. The essential requirements for the mill are a site where water can be obtained the year round, where the land is relatively dry to facilitate the handling of the material from the stacks during all periods of the year, and also, if possible, close proximity to a power line.

The erection of a mill in a district is quite a big consideration to that area, as normally there would be quite a number of hands employed, and the mill would be working full time the year round. When the straw is received at the factory, and after weighing and stacking, at a time convenient to the general economic management of the mill, the straw is deseeded by pushing the heads between revolving metal rollers, the seed being subsequently cleaned by winnowing. Usually, the chaff is sold for feed while the seed is retained for sowing, but when surplus seed is available this is sold for oil extraction and linseed meal. After deseeding the straw is ready for retting. Retting is the technical term given to the process by which the fibre is reduced to a stage at which it can be separated from the rest of the material comprising the stem.

The most notable achievement in recent years has been the perfecting of the new method of retting which only takes as many hours as previous methods took days. While primitive methods of treating the flax straw may be effective in countries where there are relatively low standards of living, experience over a long period of years, and the success achieved in the past few years, clearly demonstrate that only the best technique, and the most efficient organisation, both financial and industrial, will do in Australia. In modern practice retting is carried out in tanks in the presence of warm water; the process exploits the activity of various bacteria always associated with flax straw; these organisms cause the decomposition of the material which binds the fibre together. By this process retting can be accomplished in a comparatively short time, while the old process of water or dew retting required anything from six weeks or more. The processing in this State for the first year will not involve the water retting method but one of decortication. After retting the material which is still in sheaf form is then put out and dried. After drying it is taken direct to the breaking and scutching machine. The straw is first put through a series of fluted rollers called the breaker, which cracks up the woody portion of the stem leaving the fibres intact with the woody parts still hanging on them. The broken fragments called shives are then beaten off with revolving blades. The modern breaker and scutcher does the whole process rapidly and automatically.

Fertilisers – Amendments to Registrations.

Since the publication of the List of Registered Fertilisers in the December and March *Journals*, the following fertilisers have been amended as in the accompanying table:—

Name of Fertiliser.	Reg. No.	Brand.	By Whom Registered.	Nitrogen (N_2) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O) as		Cash Price per ton on Rail, Perth.
				Nitrate.	Ammonia.	Blood and Bone.	Bone Dust.	Water Sol.	Citrate Sol.	Acid Sol.	Total.	Sulphate	Muriate.	
				%	%	%	%	%	%	%	%	%	%	£ s. d.
Potato Manure "B"	12	Sickle	Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd.	....	3·75	...	....	14·50	·35	·75	15·60	4·50		7 2 0*
Amended	12	do.	do. do.	....	3·00	....	....	16·25	·50	1·00	17·75	2·40	....	....
Potato Manure "C"	13	do.	do. do.	....	3·50	....	....	16·75	·40	1·10	18·25	....	....	5 16 0*
Amended	13	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Potato Manure "E" ...	14	do.	do. do.	....	3·50	....	....	14·00	·30	·70	15·00	8·00	....	7 19 0*
Amended	14	do.	do. do.	....	3·00	....	....	15·00	·50	1·00	16·50	4·80	....	....
Orchard Manure	19	do.	do. do.	....	2·00	....	....	15·75	·40	1·10	17·25	....	5·00	6 6 0*
Amended	19	do.	do. do.	....	2·05	....	....	17·00	·50	2·00	19·50	....	2·50	....
Special Mixture "K"	20	do.	do. do.	....	8·34	. .	.	8·40	·20	·40	9·00	....	10·04	10 2 6*
Amended	20	do.	do. do.	....	4·10	....	....	13·50	·50	2·00	16·00	....	5·00	....
Super and Ammonia, No. 1	22	do.	do. do.	....	2·94	....	....	17·57	·43	·85	18·85	....	....	5 10 6*
Amended	22	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Potato Manure No. 2	40	ML in diamond	do. do.	....	3·50	....	....	16·75	·40	1·10	18·25	....	....	5 16 0*
Amended	40	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Potato Manure No. 3	41	do.	do. do.	....	3·75	....	....	14·50	·35	·75	15·60	4·50	....	7 2 0*
Amended	41	do.	do. do.	....	3·00	....	....	16·25	·50	1·00	17·75	2·40	....	....
Potato Manure No. 4	42	do.	do. do.	....	3·50	....	....	14·00	·30	·70	15·00	8·00	....	7 19 0*
Amended	42	do.	do. do.	....	3·00	....	....	15·00	·50	1·00	16·50	4·80	....	....
Orchard Manure	47	do.	do. do.	....	2·00	....	....	15·75	·40	1·10	17·25	....	5·00	6 6 0*
Amended	47	do.	do. do.	....	2·05	....	....	17·00	·50	2·00	19·50	....	2·50	....
Special Mixture "K"	48	do.	do. do.	.	8·34			8·40	·20	·40	9·00	...	10·04	10 2 6*
Amended	48	do.	do. do.	....	4·10	....	....	13·50	·50	2·00	16·00	....	5·00	....
Super and Ammonia, No. 1	50	do.	do. do.	....	2·94	....	....	17·75	·43	·85	18·85	....	....	5 10 6*
Amended	50	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Potato Manure "B"	68	CSML	do. do.	....	3·75	....	....	14·50	·35	·75	15·60	4·50	....	7 2 0*
Amended	68	do.	do. do.	....	3·00	....	....	16·25	·50	1·00	17·75	2·40	....	....
Potato Manure "C"	69	do.	do. do.	....	3·50	....	....	16·75	·40	1·10	18·25	....	....	5 16 0*
Amended	69	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Potato Manure "E"	70	do.	do. do.	....	3·50	....	....	14·00	·30	·70	15·00	8·00	....	7 19 0*
Amended	70	do.	do. do.	....	3·00	....	....	15·00	·50	1·00	16·50	4·80	....	....
Orchard Manure	79	do.	do. do.	....	2·00	....	....	15·75	·40	1·10	17·25	....	5·00	6 6 0*
Amended	79	do.	do. do.	....	2·05	....	....	17·00	·50	2·00	19·50	....	2·50	....

* On rail at Works.

FERTILISERS—AMENDMENTS TO REGISTRATIONS—*continued.*

Name of Fertiliser.	Reg. No.	Brand.	By Whom Registered.	Nitrogen (N_2) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O) as		Cash Price per ton on Rail, Perth.
				Nitrate.	Ammonia.	Blood and Bone.	Bone Dust.	Water Sol.	Citrate Sol.	Acid Sol.	Total.	Sulphate.	Muriate.	
			Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd.	%	%	%	%	%	%	%	%	%	%	£ s. d.
Special Mixture "K"	80	CSML		....	8·34	....	....	8·40	·20	·40	9·00	....	10·04	10 2 6*
Amended	80	do.	do. do.	....	4·10	....	....	13·50	·50	2·00	16·00	....	5·00	....
Super and Ammonia, No. 1	82	do.	do. do.	....	2·94	....	....	17·57	·43	·85	18·85	....	....	5 10 6*
Amended	82	do.	do. do.	....	3·00	....	....	17·50	·50	1·00	19·00	....	....	....
Special Orchard Manure	103	Cresco	Cresco Fertilisers (W.A.), Ltd.	....	8·34	....	....	8·40	·20	·40	9·00	....	10·04	10 5 0
Amended	103	do.	do. do.	....	4·10	....	....	13·50	·50	2·00	16·00	....	5·00	....
Potato Special	104	do.	do. do.	....	4·00	....	....	12·70	·30	·70	13·70	9·00	....	8 10 6
Amended	104	do.	do. do.	....	3·00	....	....	15·00	·50	1·00	16·50	4·80	....	....
Batsos	142	Batsos	Batsos Trading Co.	....	....	....	1·00	1·25	1·00	1·75	4·00	Trace	Trace	Price on application
Amended	142	do.	do. do.	....	....	....	Trace	·24	1·00	·76	2·00	Trace	Trace	

* On rail at Works.

Fertilisers — Additional Registrations.

Since the publication of additional regulations in the March issue of the *Journal*, the following fertilisers have also been registered.

Name of Fertiliser.	Reg. No.	Brand.	By Whom Registered.	Nitrogen (N_2) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O) as		Cash Price per ton on Rail, Perth.
				Nitrate.	Ammonia.	Blood and Bone.	Bone Dust.	Water Sol.	Citrate Sol.	Acid Sol.	Total.	Sulphate.	Muriate.	
				%	%	%	%	%	%	%	%	%	%	£ s. d.
Blood and Bone	143	P over BB	Paton Burns & Co.	....	....	5·25	....	....	8·0	4·0	12·0	....	....	6 12 6†
Do. do.	144	Wooltana	Modra Homann, Wooltana Fertilisers, Ltd.	....	....	6·00	....	....	....	11·5	11·5	....	....	9 5 6
Cockbill's Blood and Bone	145	Cockbill	J. Cockbill	....	....	5·25	....	....	3·0	9·0	12·0	....	....	11 10 0
Fall's Bone Fertiliser	146	Fall's	W. H. Logie & Son	....	....	....	3·0	....	6·0	15·0	21·0	....	....	8 10 0
No. 1	147	Wooltana	Modra Homann, Wooltana Fertilisers, Ltd.	....	....	4·0	....	1·37	·92	9·2	11·31	....	....	8 17 0
Potato Manure, No. 1	148	Cresco	Cresco Fertilisers (W.A.), Ltd.	....	3·0	....	....	17·50	·50	1·00	19·00	....	....	7 5 6*
Do. No. 2	149	do.	do. do.	....	3·0	....	....	16·25	·50	1·00	17·75	2·40	....	8 0 0*
Orchard Manure	150	do.	do. do.	....	2·05	....	....	17·00	·50	2·00	19·50	2·50		7 10 6*
Limax	151	Limax	Harris, Scarfe & Sandovers	Trace	Trace	....	....	....	....	....	Trace	Trace		10 0 0‡
Blood and Bone	152	Xlint	Barron Linton & Co.	....	....	5·00	....	....	7·00	7·00	14·00	....	....	....
Bone Dust	153	Albany Freezing Works, Ltd.	Albany Freezing Works, Ltd.	....	....	....	3·5	....	....	22·00	22·00	....	....	8 0 0

* On rail at Works. † F.O.B. Sydney. ‡ 45·6% Calcium oxide CaO (in the case of Agricultural Lime).

Dairy Farming and Pig Raising at Brunswick.

M. Cullity, Senior Agricultural Adviser.

Brunswick is a township on the main Perth-Bunbury road, 100 miles from Perth. It is situated at the edge of the foothills of the Darling Range and its farming properties spread from these foothills, over the coastal plain.

During the past few years irrigation waters have been available and farmers have made great efforts to improve their paddocks with regard to their layout, size, surface, and pasture constituents, so that they could make use of the water most efficiently.

Dairy Production.

Dairy production in the district is marketed as whole milk, cheese milk or cream. The proportion of the total butterfat marketed as whole milk was 28 per cent. while very much the greater amount of the remainder was marketed as cream. For the whole milk trade a treatment plant is installed in the town of Brunswick, where also a cheese factory operates for a portion of the year only. Cream producers have the option of supplying either of two factories belonging to one company, which are situated approximately 15 miles away in different directions. Those desiring another market, forward their cream by rail to another company approximately 80 miles away.

A Herd Recording unit has been operating in the district since 1933 and the table hereunder shows that farmers have utilised the information which became available.

Table 1.

Year.	Number of Cows Tested.	Average Production Butter Fat. lbs.
1933–34	649	169·20
1934–35	615	206·00
1935–36	598	217·20
1936–37	623	231·32
1937–38	575	253·15
1938–39	654	284·37

The success achieved by farmers led them to a consideration of other methods of surveying farm results and some desired to see some measure of production made on the unit of one acre. This desire was the result of the feeling that high average production per cow did not necessarily indicate efficient farm management as distinct from herd management. Some information on this particular point is given later in this report.

It was with the object of meeting this expressed wish of the farmers that the local branch of the Primary Producers' Association and Messrs. Brownes Ltd., milk dealers and cheese manufacturers, made available trophies for the owners of the farms producing the greatest quantity of butterfat from each acre. There were two sections, one for irrigated and one for dry farms.

As farming operations in this area vary from dairying only to dairying combined with pig-raising, and fat lamb production, it was necessary to devise some means by which comparisons between farm and farm could be carried out. This was eventually arranged according to the following method.

A questionnaire was completed by each farmer. This disclosed the acreage of pasture of each property. It also gave details of the various classes of livestock. According to the scale given, hereunder, the number of livestock units on each property was calculated:—

TABLE 2.

One livestock unit is the equivalent of—

1 cow.
1 bull.
1 horse.
1 steer over 2 years.
2 steers over 1 and under 2 years.
1 heifer over 2 years.
2 heifers over 1 and under 2 years.
4 calves.
8 sheep.
14 lambs.

As a cow constitutes one live stock unit it was then a simple calculation to estimate the number of acres which would be used by the cows, assuming all types of stock received the same treatment regarding pasturage.

The actual production of butterfat from each farm was collected from factory statements, and allowances for calf feeding, and for consumption of milk, butter and cream in the home were made.

The total amount of butterfat so obtained was then divided by the number of acres utilised by the milking cows (cow-acres) and the result is stated as the production of the farm per acre. It was upon these figures that the competition was decided.

In table 3 are shown the results. Column A represents the basis as above, on which the competition was determined. Column B shows the production calculated on an area sufficient to run all the dairy stock held on each farm, while in Column C are the figures calculated on the full area of pasture on the farm.

TABLE 3.

Farmers.	Production per acre.		
	A. Acres used for Cows.	B. Acres used for Dairy Stock.	C. Total Pasture (acres).
Farm	Butter Fat lbs.	Butter Fat lbs.	Butter Fat lbs.
1	169·5	101·7	101·7
2	153·4	133·7	93·2
3	142·0	122·0	97·7
4	125·7	100·6	90·5
5	123·5	108·0	100·0
6	113·2	90·6	80·5
7	110·8	100·3	77·5
8	107·4	98·7	80·1
9	106·0	74·0	64·3
10	104·6	85·1	62·0
11	98·2	95·1	69·9
12	85·5	45·1	41·7
13	84·5	68·5	29·5
14	83·0	72·0	67·0
15	74·2	63·7	62·5
16	64·5	47.0	24.6
17	57.1	48.4	37.0

Where the figures in columns A and B are close it indicates that very few dairy stock other than milking cows are being held. Conversely where wide differences occur it can be accepted that there are a large number of dairy stock not yet in production.

High producing heifers.

[S. Bowers, Brunswick.]

As an instance of the former, the case of Farm No. 11 may be cited. Here the figures are 98.2 lbs. and 95.1 lbs. respectively. On this farm the average number of stock carried through the year was 71 cows, 6 heifers and 2 bulls, while as an example of the latter position, Farm 12 shows production of 85.5 lbs. and 45.1 lbs. respectively in these columns. This farm is still in the developmental stage and a large number of young stock are carried in order not only to replace culls, but also to increase the size of the herd. The actual number of the various classes of stock on this property was as follows:—

32 cows.
16 heifers over 2 years.
12 heifers—yearlings.
12 heifers—calves.
1 bull.

This farm had a low output of butterfat on a dairy stock acreage, but in a year or two when the herd has increased in size, the total production will increase rapidly.

Differences between columns B and C indicate the degree to which stock other than dairy cattle are carried. For example Farm No. 1 is stocked entirely with dairy cattle while Farm No. 2 is carrying many sheep.

Herd Replacement.

Table 4 indicates the position regarding disposals and purchases of cows and the numbers of heifers which freshened during the year.

In the seventeen herds there was an increase of five cows only. One hundred and thirty-one (131) cows were sold while new heifers calving and fresh purchases amounted to one hundred and thirty-six (136).

The causes of the disposals may be taken as being similar to those pertaining for the year 1939-40 in the Grade Herd Recording Unit for the district.

TABLE 4.

Farm.	Number of Cows in Herd.	Number of Cows Sold during Year.	Number of Cows Bought during Year.	No. of Heifers.			
				Freshened.	Over 2 Years.	Between 1 and 2 Years.	Under 1 Year.
1 ...	21	7	7	4	5	5	14
2 ...	62	3	...	...	...	7	9
3 ...	24	8	1	2	...	4	4
4 ...	19	3	3	...	...	4	3
5 ...	60	...	22	15	...	5	6
6 ...	55	9	...	7	1	11	21
7 ...	19	...	...	3	...	...	5
8 ...	48	5	...	11	...	7	22
9 ...	42	11	...	...	11	18	8
10 ...	36	6	3	7	...	11	10
11 ...	71	19	8	15	...	6	3
12 ...	32	...	...	...	16	12	13
13 ...	84	29	...	8	5	9	26
14 ...	87	7	...	12	...	12	27
15 ...	32	6	...	...	...	5	6
16 ...	41	12	2	6	8	15	9
17 ...	50	6	...	...	6	8	10
	783	131	46	90	52	139	196

Six hundred and thirty-five (635) cows were recorded, and one hundred and six (106) were culled.

The causes for culling were as follows:—

Low production	72	68% of culls.
Old age	3	2.8% of culls.
Failure to breed	5	4.7% of culls.
Faulty and diseased udders	14	12.2% of culls.
Contagious abortion	3	2.8% of culls.
Surplus stock	2	1.8% of culls.
Milk fever (deaths)	7	6.6% of culls.
Total	106	16.7% of culls.

Of the one hundred and thirty-six (136) replacements ninety (90) only were heifers reared on the farms where they calved. This means that only two thirds (2/3rds) of the replacement stock were held on the farms in that year.

From the foregoing, it appears that heifers to the number of seventeen per cent. (17%) of the number of cows in each herd should have been held on the farms for replacement purposes. Where development of the properties for dairying is still in progress, a greater proportion of heifers would be required.

An examination of the position in the herds at the moment with reference to future requirements indicates that sufficient young stock are available in the district. Actually the number of heifers over one year of age and of those under one year amount to twenty-three and twenty-five per cent. respectively of the number of cows. But a closer perusal of the position as disclosed by Table 4 shows that while a number of farmers are breeding sufficient heifers for replacement and

development, others are relying on purchases to remedy the position. For example Farm No. 5 has heifers to the amount of 8½ per cent. only of the herd size. In the previous year, thirty-seven per cent. (37%) of the herd was purchased.

Farm No. 11 had the following record during the year. Nineteen cows were sold, eight cows were purchased and fifteen heifers calved, bringing the herd up to seventy-one (71) cows. At that time heifers to the number of 8 per cent. of the herd size for the 1939 season and 4 per cent. for the 1940 season were available for replacement purposes.

It follows that this farmer must go to the saleyard to obtain his requirements of replacement stock. This put him in the very great danger of bringing disease into the herd, which would more than counter-balance any advantage gained during a few years by stocking the farm with the maximum number of cows. There is no necessity to place any greater emphasis than this on the financial loss that results from the introduction of contagious abortion, infectious mammitis, etc., into a dairy herd.

Apart from a consideration of the foregoing it is interesting to note that the quality of some at least, of the heifers in this district are very satisfactory. The bulls in use are practically without exception pure bred, and the effect of the emphasis placed on the necessity for production backing for the bulls and more recently on "proved bulls," is shown in the quality of the young stock.

The following figures are taken from the annual report of the unit as furnished by the Recorder (Mr. S. A. Hardy). The unit average was 283 lbs. butterfat. The mature cows tested produced 308 lbs. each while the 3 and 2 year old heifers had figures of 306 lbs. and 292 lbs. respectively (adjusted to a mature cow basis). This indicates that the quality of the young stock is certainly not falling but is in fact higher than mature cow averages in most other units.

Among the various factors focussing attention on quality in heifers, is a trophy awarded each year to the owner of the four highest producing heifers in any one herd in the unit. This is the S. A. Mitchell Cup. The average productions for the winning team and for the past four years, are as follows:—

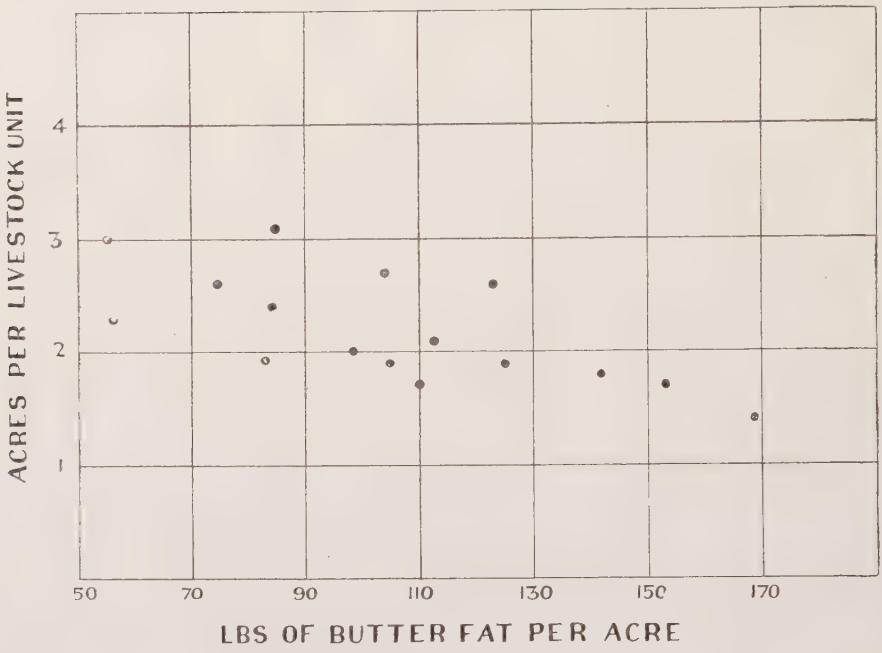
1936-37	342 lbs. butterfat.
1937-38	326 lbs. butterfat.
1938-39	337 lbs. butterfat.
1939-40	396 lbs. butterfat.

Naturally each year the trophy is won by a different team, and in the four years, the teams represent three different herds.

Carrying Capacity.

This is one of the problems of the dairy farmer to decide just what degree of stock concentration will give the greatest total output. It is axiomatic that the concentration of stock must not go beyond the limits where a sufficiency of fodder is available to give high individual production per cow. Beyond this stage the farm becomes overstocked and there is insufficient feed available above the maintenance requirements of the herd, to provide the nutrients for free milk production.

In this competition it is demonstrated that the area used per cow unit was much less than that normally considered necessary. In the final Better Dairying Competition concluded in 1936, it was shown that the average area required per "cow unit" was 4.25 acres, while approximately 3 acres were required per live stock unit.



RELATIONSHIP OF STOCKING CONCENTRATION AND PRODUCTION PER ACRE.

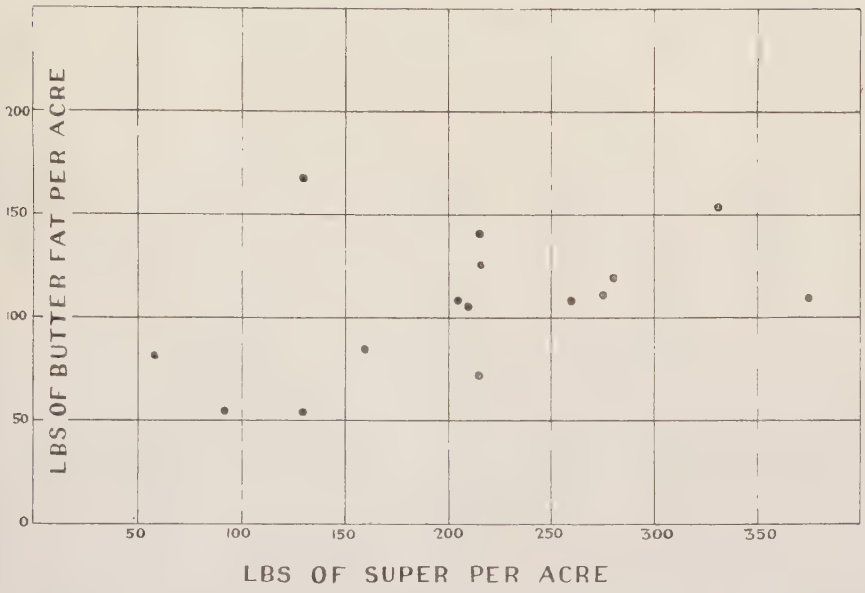
Results on this occasion, however, indicate that 2.8 acres only were needed per cow unit and 2.3 acres per live stock unit.

In the case of the leading farms the position was as follows:—

Type of Farm.	Farm Number.	Acres per—	
		Cow Unit.	Live Stock Unit
Irrigated	1	2·4	1·43
	2	2·0	1·72
	3	2·7	1·80
Dry Farm	9	2·9	1·90

Block A shows that there appears to be some correlation between stocking concentration and production per acre, but insufficient evidence is available to permit of any suggestion regarding the optimum degree of stocking. This obviously would vary according to the proportion of irrigated land, the quantity of fertiliser applied, the number and size of the paddocks, and many other factors.

That there also appears to be a definite relationship between the quantity of superphosphate used per acre and the stocking concentration is shown by Block B.



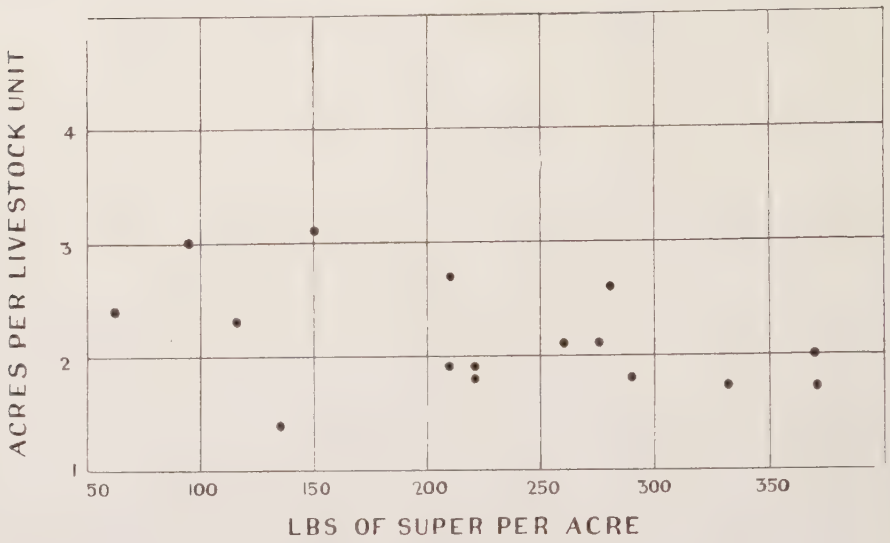
RELATIONSHIP OF RATE OF SUPERPHOSPHATE APPLICATIONS AND PRODUCTION PER ACRE

In Block C it will be noted that the highest return per acre was obtained with a small application of super. In seeking for an explanation of this, the following information was obtained which probably explains, in part at least, why such results were possible.

The property in question is portion of the homestead section of the former Brunswick State Farm. It surrounds the site of the stables and cow sheds. It was stated that this area was particularly heavily fertilised over a period of years with artificial manures of various types. In addition, the dung and refuse from the stables and bails were regularly spread over the paddocks. Since the occupancy of the present owner, no fire has been allowed to clean up dry grass in the paddocks so that the soil has had its supply of organic matter considerably increased. Whether the property is now in the state that it will continue for some time to give high yields with small applications of manure, it is impossible to say.

The general conclusion which may be drawn from Block C, however, is that high production has followed high rates of application of super. That there is a considerable margin of profit in the higher dressings can be proved by a single calculation from the data in the block.

It is considered that there is evidence in this block as to how farmers may increase the turnover from their properties. This evidence is amply supported by numerous cases in other districts where increased production has followed increases in the rate of applications of superphosphate.



RELATIONSHIP OF RATE OF SUPERPHOSPHATE APPLICATIONS AND CARRYING CAPACITY.

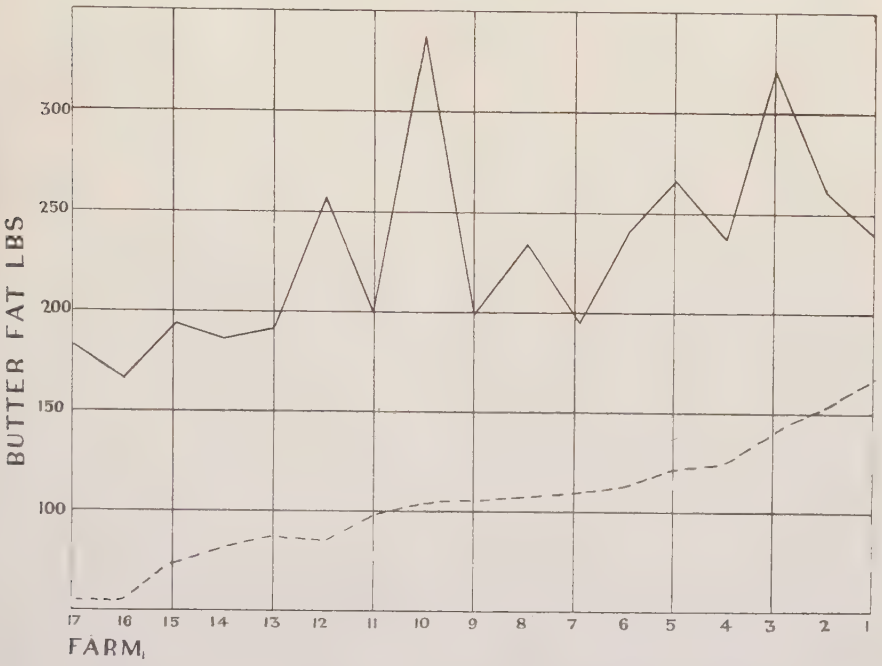
Production per Cow v. Production per Acre.

The comments made at the conclusion of the preceding section should not be read to mean that an increased application of superphosphate in itself, without any further effort on the part of the farmer, will return added production. It is necessary to make such provision that it will be possible for stock to utilise the additional feed produced economically, i.e., by adequate subdivision, watering facilities and the adoption of a proper system of controlled grazing. The references to the relationship between superphosphate applications and stocking concentration does not infer that a farmer can order an extra ton of superphosphate and an extra cow at the same time. A warning must be given against the disaster that can follow overstocking.

It can be shown that the way to increased production per acre is through increased production by each individual of the herd. Naturally with a certain herd size the higher the production per cow the higher the total production; farmers must not be led astray in discussing this matter by the occasional references to cases where increased production per cow has been achieved by a reduction in the number of the cows.

Block D shows a comparison between the production per acre and production per cow for the 17 farms. It will be noted that the general trend of production per cow is upward, while production per acre is increasing. It is interesting to investigate the high peaks in the curve for production per cow. The herd on farm 10 averaged 343 lbs. butterfat for 36 cows. The stocking concentration, however, was very low, 3.7 acres being utilised per cow unit, and 2.7 acres per live stock unit. Approximately 145 acres of pasture were available, 1.25 tons of hay per cow were conserved in addition to there being 22 acres of summer irrigation

and 18 acres of winter pasture started by irrigation water. On comparison with the other properties it appears as if more stock could profitably be run on this property.



COMPARISON OF PRODUCTION STATED AS PER ACRE, AND AS PER COW

BUTTER FAT PER ACRE - - - - - -
PER COW ———

On farm 12 also the stocking concentration is light because the property is still in the development stage and the herd is being built up wisely by breeding heifers. In this case 3.1 acres per live stock unit and 3.4 acres per cow unit were available.

On Farm 3 stocking was heavier, 1.7 acres per live stock unit being available.

Irrigation.

Comparison between irrigated and non-irrigated properties is given in Table 5.

Unfortunately there were only a few properties where irrigation was not being practised to some extent at least and therefore the comparison cannot be considered as complete.

Six farms had more than 40% of the cow acres irrigated and these averaged 127 lbs. of butterfat per acre.

Seven farms, excluding the non-irrigated properties, had less than 40% of the cow acres irrigated and averaged 106 lbs. of butterfat per acre.

TABLE 5.

Irrigated Farms.		Tons Hay Cow.	Non-irrigated Farms.		Tons Hay Cow.
Name.	Butter Fat lbs. per acre.		Name.	Butter Fat lbs. per acre.	
R. C. W. Smith ...	169·5	·75	S. A. Mitchell ...	106·0	·30
Farm No. 2 ...	153·4	·50	Farm No. 16 ...	64·5	·20
Do. 3 ...	142·0	...	do. 17 ...	57·1	·12
Do. 4 ...	125·7	·166			
Do. 5 ...	123·5	·66			
Do. 6 ...	113·2	·6			
Do. 7 ...	110·8	1·0			
Do. 8 ...	107·4	...			
Do. 10 ...	104·6	1·25			
Do. 11 ...	98·2	...			
Do. 12 ...	85·1	·62			
Do. 13 ...	84·5	·18			
Do. 14 ...	83·0	·9			
Do. 15 ...	74·2	...			

Conservation of Fodder.

The amount of fodder conserved per cow is shown in Table 5. It will be noted that the quantities are very small, the greatest being 1.25 tons per cow.

It is popularly assumed among these farmers that summer irrigation, followed by starting the winter pasture with irrigation water, obviates the necessity for conserving any great quantity of fodder. This is because green feed is available during the summer months and the winter pastures have made growth when

In the Brunswick hill country. Raking clover burr by hand.

watered early, before the summer pastures lose their usefulness. Naturally there is some point in this argument, but unfortunately several factors still operate which make sole reliance on the pasture extremely dangerous. For example, in many cases it is doubtful whether sufficient growth can be obtained from the relatively small areas of irrigated pasture to adequately feed the herd. Again the growth of the winter pastures slackens and becomes almost dormant during the wet cold months of June and July, and ample hand feeding is then required.

Home-made rotary broom for sweeping clover burr.

The position at this period is considerably worse when a rainfall above average is encountered. The winter pastures are then so sodden that little effective use can be made of them.

This actually proved the case during the 1939 season, when the supplies of fodder conserved during the 1938 harvest were utilised. The effect of this deficiency of feed is shown in the results of the Grade Herd Recording Unit for 1939-40

Normally the production of cows which complete a full 273 days' test is considerably higher than those which do not complete this period. This seems obvious. But in the Brunswick unit in 1939-40, the cows which completed 273 days did not produce more than those which were not tested for the full period. The bulk of the former group calved in May and June.

Table 6.

	Cows Completing 273 days.		Unit Average.
	Per cent.	Butter Fat Average—lbs.	
1938–39	62·7	293·84	284·37
1939–40	72·0	250·74	251·88

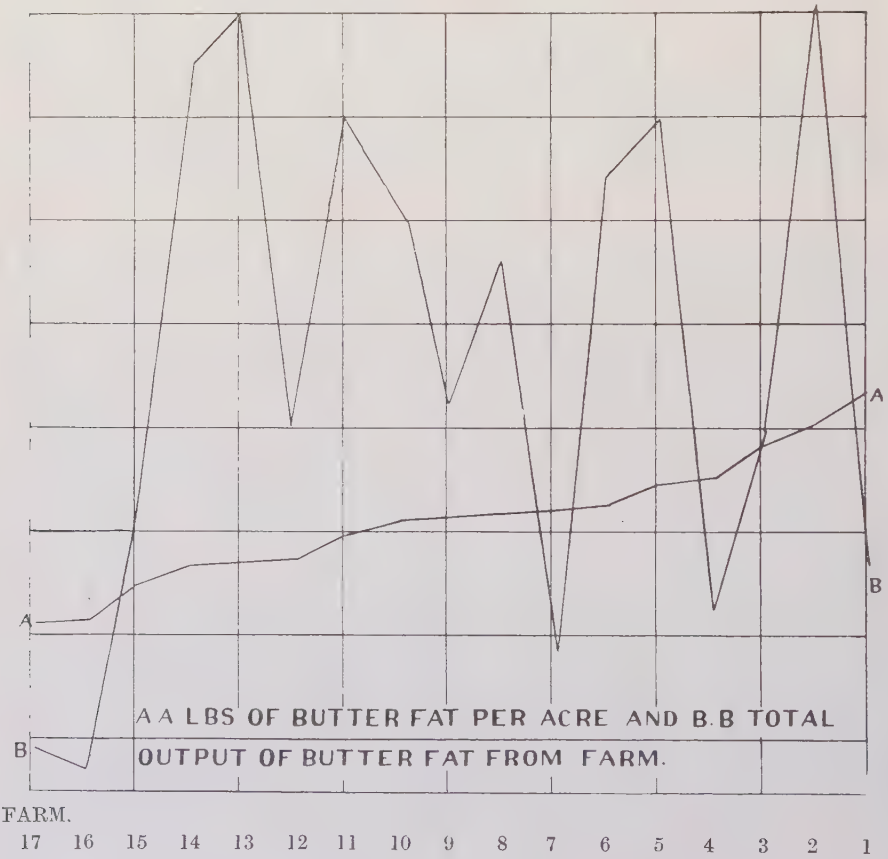
That the absence of sufficient fodder for the cows calving in May and June was responsible for the low production is indicated in Table 7.

Table 7.

Averages of Cows Calving in May and June, 1939.

	May.		June.	
	No. of Cows.	Average.	No. of Cows.	Average.
Hay Available	43	265	30	269
No Hay Available	64	214	51	237

It is hoped that as a consequence of this position, farmers will make adequate reserves during the coming season. It is suggested that the conservation of 1.5 tons of hay per cow should be the aim where ample irrigated pasture is available and the equivalent of 2½ tons per cow as hay, silage or green crops where no summer grazing is possible.



Total Output and Production per Acre.

As expected there is no relationship between the total output of butterfat from the farms and their average production per unit of area. The size of the properties varied over wide limits and in some cases more than offset the effect of the relatively low unit production.

The fact that there is no connection between total output and average per acre answers the criticism that high production per acre is more likely on the smaller properties which would therefore command an advantage in a comparison of this kind.

To illustrate this point, attention is directed to the fact that the four properties producing the greatest quantities of butterfat are placed second, thirteenth, fifth and fourteenth in the order of their production per acre. Actually the property which produced the greatest amount of butterfat had the second highest average per acre.

In block D is shown a comparison between the total figure and the average.

The natural corollary of this position, of course, is that by increasing the production per acre, no matter what size the farm may be, the total output will be increased, and under normal conditions allow a greater margin of profit to the farmer.

Method of Milking.

It is interesting to record that on the leading four farms, the herds are milked by hand labour. On all the others, with the exception of two (2), machines are in use. Of the 11 machines in use, seven were of the one type.

It has been been suggested that the labour, usually family labour which was available on the leading farms, contributed to the higher production. This suggestion was developed with the thought that the labour would be available for other work on the property such as fencing, clearing, irrigation, conservation of fodder, etc., thereby allowing the owner more time to devote to a plan of development and increased carrying capacity. No evidence was collected to confirm or disprove this argument.

A comparison of the number of cows milked by hand labour and machine showed that there was little difference between the average numbers per man and per unit. The figures were 9.25 and 12.5, respectively.

The advantage of the machines, however, becomes obvious when the number of cows attended per man is calculated. Over the eleven properties 24 cows were attended in the milking shed per man.

One conclusion which may safely be drawn from this is that there is still ample capacity for development in the size of the herds where machines are in use before it will be necessary to procure larger machines.

The only additional cost for some time, as the herds increase in size, would be on account of longer periods of operation. Usually machines have sufficient reserve power and vacuum pump capacity to allow extra units to be added without requiring other changes.

Pig Raising.

Table 8 shows the position regarding the production of pigs. It has been considered convenient to give this in terms of the pounds of pig meat produced per 100 pounds of butterfat. The figures are not the result of weighing the pigs individually but have been calculated according to the number and type of pig sold.

Only five farmers kept sows and the cow to sow ratio is shown for each of these properties. It varies from 12.5 : 1 to 4.2 : 1. It will be seen that the average production of pig meat per 100 lbs. of butterfat produced as cream from these farms was 60 lbs. Where store pigs were purchased and fattened an average of 45 lbs. was produced. It is possible that by buying stores a farmer may produce as much pig meat as if he had a number of brood sows, but the above shows that in actual practice he does not. Actually it may be considered that the farmers whose results are being discussed have produced more pigs than appears to be the case in an equivalent group of farmers in other districts. This it is considered shows that they are fully alive to the opportunities for increased revenue which the pig industry offers. Therefore the evidence which is given herein showing a greater production of pigs from the properties where the pigs are bred should move them into acquiring sows.

There are probably a variety of reasons why the farmer buying stores does not make the same turnover. Possibly pigs are hard to get when he requires them or the price may be too high. Further, to show the same amount of pig meat actually grown on the properties it is necessary for him to handle a greater number of pigs.

It follows then that to keep a supply of good pigs available for fattening, the only sure way is to breed them. A further reason for doing this is that the risk of the pigs contracting disease is greatly reduced if no purchases in the ordinary market are made.

TABLE 8.

Farm No.	Cows.	Sows.	Sow : Cow Ratio. 1 :	Store Pigs Purchased.	Lbs. Pig Meat Sold per 100 lbs. Butter Fat.
16	41	5	8·2	45	107
9	42	10	4·2	...	94
6	55	5	11·0	...	58
13	84	10	8·4	...	36
17	50	4	12·5	...	35
7	19	...	...	30	65
8	48	...	...	100	54
10	36	...	...	27	30
3	24	...	...	50	27·2
4	19	...	...	26	26
12	32	...	...	44	17
11	71	...	...	8	7

A study of Table 9 also gives much information on the results that can be achieved by utilising skim milk efficiently, that is, by feeding it with cereal grains and other farm produced materials which not only enable more pigs to be fed but keeps the cost of feeding to a low figure.

Farm 9 had a sow:cow ratio of 4.2:1 and produced 94 lbs. of pig meat per 100 lbs. of butterfat. Actually this farm with a herd of 42 cows was able to return the owner more than £200 profit over the cost of purchased feeds. Wheat and pollard were purchased and crops of pumpkins and peas were grown.

Farm 16 had 5 sows but 45 store pigs were also purchased because a good supply of maize grain was on hand. The sow : cow ratio when the purchase of store pigs was taken into account is lower than 8.2 : 1. Had sows produced the

pigs on the property the ratio would have been 4.5 : 1. The cost of the maize grain was low and the margin of profit on the total number of pigs was very satisfactory.

Table 9 gives some idea of the returns obtained from pigs when expressed as an equivalent of butterfat per acre.

TABLE 9.

Return from Pig Meat at 6d. per lb. calculated as equivalent of Butter Fat per acre, Butter Fat at 1s. 3d. per lb.

Farm No.	Pig Meat per acre at 6d. per lb.	Lbs. Butter Fat at 1s. 3d. per lb.	Butter Fat per acre.	Total Cream and Pigs as Butter Fat per acre.
1	...	...	169·5	169·5
2	...	...	153·4	153·4
3	13/6	17·6	142·0	159·6
4	16/6	13·0	125·0	138·0
5	...	...	123·5	123·5
6	33/–	26·0	113·2	139·2
7	36/–	29·0	110·8	139·8
8	27/–	22·0	107·4	129·4
9	49/6	40·0	106·0	146·0
10	15/–	12·0	104·6	116·6
11	3/6	3·0	98·2	102·2
12	7/–	6·0	85·1	91·1
13	15/6	13·0	84·5	97·5
14	...	...	83·0	83·0
15	0/6	0·5	74·2	74·7
16	30/-	24·0	56·2	80·2
17	10/–	8·0	55·3	63·3

Egg Laying Trials—Muresk Agricultural College. 1939-40.

G. D. SHAW, Poultry Adviser.

The 1939-40 trial is the fifth of the second series conducted at Muresk Agricultural College. Seven previous trials were held prior to 1936, but a break occurred in the years 1933-35.

The duration of the trial is 48 weeks, beginning on the 16th March, 1939, and ending on the 1st February, 1940.

The trial for the year 1940-41 began on the 21st March and will continue until the 14th February, 1941.

A total of 336 birds were entered for the 1939-40 trial, being composed of:—Australorps 150, white leghorns 144, brown leghorns 6, Rhode Island reds 36.

Management.

The management of the trial is in the hands of a committee which consists of the Principal of the College (Mr. W. Southern), Chairman, the Poultry Adviser of the Department of Agriculture, Mr. G. D. Shaw; the Assistant Poultry Adviser, Mr. E. Lovegrove; Mr. S. Dolman, Cranleigh Poultry Farm, Welshpool; Mr. F. Landquist, York, and Mr. R. Knight, Kenwick.

The committee of management meet at the college periodically and directs the policy of the trial.

There are 336 pens available, and all birds are single tested. All eggs are weighed daily and the scales used are tested and graduated to one-tenth of an ounce.

The college is situated 60 miles from Perth. The soil is ideal and plenty of green feed is available in all seasons of the year. In the height of summer all the pens are shaded with a luxuriant growth of foliage from cape lilacs which have been planted between the rows.

The rules of the 1939-40 trial were as follow:—

Committee of Management.

The committee of management shall consist of the Principal of the College, the Poultry Adviser, Assistant Poultry Adviser, Department of Agriculture, or officers acting in their stead, and three representatives elected by the breeders taking part in the preceding trial.

Note.—The term "breeder" is given to those who have entered birds in the trials.

Powers of the Committee.

The committee shall have absolute control of the trials conducted during its tenure of office.

It shall recommend what tests are to be carried out and arrange the conditions and regulations governing the same. It shall also receive applications and allot the pens for the next trial.

The representatives elected shall take office on 16th March succeeding the date of appointment.

The committee shall meet at such times as it may deem necessary.

Trial for 1939-1940.

The trial shall consist of the following sections:—

Section "A"—Pen of six birds—All light breeds.
Section "B"—Pen of six birds—All heavy breeds.
Section "C"—Pen of six birds—All medium heavy breeds.

The trial shall extend from 16th March, 1939, until 14th February, 1940 (48 weeks). The leading group or individual bird in each section may be allowed to remain at the college for the full period of twelve months.

Each breeder shall be charged an entrance fee of 5s. per bird, 2s. 6d. per bird to accompany application for pens. The balance of 2s. 6d. per bird is to be forwarded to the Principal, Muresk Agricultural College, within 14 days after notice of allotment of pens; otherwise pens may be allotted to other applicants and the 2s. 6d. application fee forfeited.

For any of the above sections pure-bred birds only must be entered.

All eggs shall be the property of the Muresk Agricultural College.

Each of the pullets will be single tested, housed (semi-intensive), and the individual numbers and weight of eggs will be kept.

Regulations.

1. In each section the trial will be decided by the highest number of first grade eggs obtained by each group of birds and by each individual bird in their respective sections.

2. Sections "A," "B," "C":—During the first two months of the trial a first grade egg shall weigh not less than 1¾ ozs., thereafter during the remainder of the trial a first grade egg shall weigh not less than 2 ozs.

Second Grade:—The minimum weight of a second grade egg shall be not more than ¼ oz. less than a first grade egg. Second grade eggs will be recorded but not counted.

3. Eggs under 1½ ozs. in weight during the first two months of the trial and under 1¾ ozs. in weight during the remainder of the trial, soft shelled, or broken will be recorded, but not counted in trial results.

4. In all sections the actual weight of each egg shall be kept.

5. The certificate for the winter test, 16th March to 31st July, 1939, shall be given subject to rules 2 and 3.

6. Progress results will be published weekly as far as practicable, and all prizes shall be awarded as soon as possible after the termination of the trial. Results to be reported under breed headings.

7. No protest shall be considered unless received within 14 days of the alleged breach of regulations, and accompanied with a deposit of £1, which deposit shall be returned if the protest is upheld, or forfeited if, after inquiry, the protest is considered to be frivolous or without foundation.

8. Records shall be kept of the average cost per head of food consumed.

9. All birds to be accepted must conform to the following conditions:—

(a) Shall be the property of the breeder;

(b) Must be not less than six months and not more than nine months of age on 16th March, 1939;

(c) Must be fair specimens of the breed;

(d) Must weigh not less than:—

	lbs.
Section "A"—Light Breeds:	
Leghorn, Ancona	3¾
Minorca	4
Section "B"—Heavy Breeds:	
Australorp	5
Sussex, Langshan	5
Plymouth Rock	5
Section "C"—Medium Heavy Breeds:	
Barnevelder	5
Rhode Island Red	5
Wellsummer	4½
Wyandotte	4½

10. All birds sent to the trial must conform with the weight prescribed in the preceding paragraph, otherwise the committee shall cancel the allotment of pens, in addition to which the entrance fee may be forfeited.

11. All birds shall be treated for vermin and delivered at the Muresk Agricultural College, Muresk, between 13th March and 15th March, inclusive, in new coops or crates, with the breeder's name and address clearly stencilled or painted thereon. Entries will not be accepted from any person whose premises are tick-infested or whose flock is suffering from any infectious or contagious disease.

NOTE.—No birds will be accepted on Sunday, 12th March, 1939.

12. Freight to the College is to be prepaid or delivery will not be accepted. **Freight on rejected birds must be paid by the breeder.**

13. All birds must be ringed with the numbered leg bands supplied and forwarded free to the breeder. These will correspond with the number of the pens allotted. The pens having overhead netting, it is unnecessary to cut any bird's wing feathers.

14. The Poultry Adviser, or his representative, shall have the power to reject any bird which in his opinion is not of the correct age, or which he considers does not conform in any way to Rule 9, and his decision shall be final.

15. Any bird found to be suffering from an infectious or contagious disease, or with crooked breasts, or side sprigs in combs, will be rejected and returned, and shall be replaced by a suitable one within seven days after the notification of same. If any bird is found infested with tick the group will be rejected, the entry cancelled, and the entry fee forfeited.

16. In the event of a bird during the course of the trial becoming diseased, incapacitated from laying, or developing vicious habits (such as egg-eating or feather-eating) it may be returned, or, on the written authority of the owner, destroyed.

Should this occur, the breeder may replace it with another bird of the same age and breed; in the case of a bird dying, replacement may be made. Any score standing to the credit of a bird which is replaced shall be struck out.

17. No breeder shall withdraw any bird until the termination of the trial, except as provided in Rule 16.

18. The committee reserves to itself the right to inspect, or to have inspected, any applicant's stock, with a view to determining whether the quality and character of the birds warrant the allotment of pens.

19 (a). Any breeder taking part in the current trial will have the right of allotment of one pen of six birds per section in the succeeding trial. After such allotment new applicants will have the right of allotment of one pen of six birds per section. Should there then be any vacant pens they will be allotted by ballot to any applicant.

19 (b). If after the allotment of pens, it is ascertained that incorrect information has been furnished the allotment may be cancelled and the birds returned. In such case the entrance fee shall be forfeited and the applicant may be debarred from entry to any future trial.

20. Any breeder violating or failing to conform to these regulations shall be subject to such disqualification as the committee may decide.

21. Where there is a tie for any place, the award shall be given to the breeder whose bird or group (as the case may be) lays the greater total weight of first-grade eggs.

22. While every care will be taken, the committee will not be responsible for loss or injury to any birds in any way in connection with the trial.

23. The committee may disqualify any breeder and may refuse entry to subsequent trials, where such breeder publishes in any way statements of records not in accordance with the official records of the trials.

24. The committee's decision in all matters shall be final.

NOTE: PRIZES.

Certificates will accompany all prizes.

No prize shall be awarded in any section unless there are at least three entries. No second prize will be awarded unless there are at least four entries.

The full schedule of prizes will be published at an early date.

CHAMPION CERTIFICATE.

A Champion Certificate will be awarded to the group pen from sections "A," "B" and "C" obtaining the highest total of first-grade eggs during the term of the trial.

GOVERNMENT STANDARD CERTIFICATE.

A Government Standard Certificate and a Registered Sealed Copper Ring will be awarded to all birds laying not less than 200 two-ounce eggs or over during the term of the trial.

DISCUSSION.

Some explanation with reference to the classes may not be out of place. In the schedule it will be noticed that light, heavy, and medium-heavy classes are defined by weight. This is not a clear interpretation of the classes. It has been found that the activity of the different breeds varies, so much so that the feeding of light birds must be on a different plane to the feed given to the heavy. It was found that the food giving the best results for light breeds was too fattening for the heavy breeds. This was because the heavy breeds were not as active as the light and therefore did not utilise the carbohydrates to the best advantage. Hence the heavy breeds are fed on a narrower ration than are the light breeds.

Again, the breeds placed into what is described as medium-heavy, are not necessarily lighter in weight than are the heavy breeds, but those placed in the medium-heavy class are more active than those breeds placed in the heavy class, yet not as active as those of the light breeds quoted. Hence the rations suitable for the medium-heavy breeds should be wider than that given for the heavy breeds but narrower than that given to the light breeds. This has been satisfactory and the feeding at the laying trial is based on the article on "Feeding" published in the Journal of Agriculture, September, 1934, pages 435 onwards, and in the December, 1936 Journal, pages 465 onwards. This system of feeding allows the birds the necessary requirements of protein and carbohydrates consistent with their activities, and the noticeable factor at the completion of each trial of the second series has been that the birds have been returned to their owners in good condition, each bird having put on weight during the period, but no bird has carried superfluous fat.

The following are the results of the trial ending 14th February, 1940:—

SUMMARY

Champion Certificate.

	Score.
N. T. Wilkinson: Australorps—	
1st grade eggs	1,256
2nd grade eggs	62
Section A—Team of 6 birds—Light breed.	
1st (Westfarmers' Cup) Mrs. M. H. Dadley —	
1st grade eggs	1,097
2nd grade eggs	3
2nd (Wright & Co. Trophy): Webb's Hatchery—	
1st grade eggs	1,075
2nd grade eggs	158
Section B—Team of 6 birds—Heavy breed.	
1st (W.A. Produce Market Cup) N. T. Wilkinson—	
1st grade eggs	1,256
2nd grade eggs	62

SUMMARY—*continued.*

Section B (*continued*):—

	Score.
2nd (R. Young Trophy) R. Harrison—	
1st grade eggs	1,231
2nd grade eggs	19
Section C—Team of 6 birds—Medium-heavy breed.	
1st (Ian Hazlett Cup) Robinson Bros.—	
1st grade eggs	990
2nd grade eggs	76
2nd (Kirkby Trophy) Cranleigh Poultry Farm—	
1st grade eggs	954
2nd grade eggs	10

Winter Test.—(from 16th March to 31st July, 1939).

Team of 6 birds—Light breeds.	
1st only (Philip Giles Trophy) Mrs. M. H. Dadley—	
1st grade eggs	480
2nd grade eggs	1
Team of 6 birds—Heavy breeds.	
1st only (Carbarns Trophy) R. Harrison—	
1st grade eggs	471
2nd grade eggs	12
Team of 6 birds—Medium-heavy breeds.	
1st only (Carbarns Trophy) Beverley Poultry Farm—	
1st grade eggs	354
2nd grade eggs	13

Summer Test.—Teams laying the greatest number of 1st grade eggs in the period December 1st to February 14th (inclusive). Teams to have laid 1,200 1st grade eggs in the period of the test. Cups donated by the Western Ice Company.

Section B—Team of 6 birds—Heavy breeds—Runnymede Poultry Farm—283 1st grade.

Teams from sections A and C did not qualify for these awards.

Section A—Highest single—Light breed.	
1st (Macfarlane Cup) Webb's Hatchery—	
1st grade eggs	256
2nd grade eggs	7
2nd (James Goss Trophy) H. P. Chalmer—	
1st grade eggs	249
2nd grade eggs	8
Section B—Highest single Heavy breed.	
1st (Bairds Co. Cup) N. T. Wilkinson —	
1st grade eggs	250
2nd grade eggs	12
2nd (Barrow Linton Trophy) Mrs. S. Dolman—	
1st grade eggs	248
2nd grade eggs	4
Section C—Highest single—Medium-heavy breed.	
1st (Enston Cup) Robinson Bros.—	
1st grade eggs	220
2nd grade eggs	0
2nd (Harrold & Murray Trophy) Robinson Bros.—	
1st grade eggs	212
2nd grade eggs	0

First bird to lay 200 first-grade eggs—

Light (J. & W. Bateman Trophy) H. P. Chalmer, Bird No. 129—2nd December, 1939. 262 days.

Heavy (T. Newby Trophy) F. Landquist & Sons, Bird No. 105—21st November, 1939. 251 days.

Medium-Heavy (R. Young Trophy) Robinson Bros., Bird No. 157—15th January, 1940. 304 days.

Special Prizes—

Robinson Trophy—Team laying lowest percentage of 2nd grade eggs (minimum total lay of 1,000 first-grade eggs)—

Mrs. M. H. Dadley (White Leghorns) 1,097 first-grade, 3 second grade.

A. S. Webb Trophy—Bird laying longest sequence of first-grade eggs—

Mrs. M. H. Dadley—Bird No. 87—69 eggs.

DETAILED RESULTS.

SECTION "A" (LIGHT BREEDS)—TEAMS OF SIX BIRDS.

Name of Competitors and Birds Nos.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	Totals. 1st.	Totals. 2nd.
T. Gent—														
1—6	109	25	30	54	144	67	206	2	164	7	207	1	860	156
R. Knight—														
7—12	192	25	85	9	214	13	105	72	29	167	162	21	787	307
13—18	82	145	194	7	146	6	175	1	126	97	150	1	873	256
Thorpe Poultry Farm—														
19—24	112	4	82	22	159	....	150	2	142	4	127	13	772	45
G. E. Robinson—														
25—30	120	5	73	91	159	3	164	28	118	7	111	22	745	156
A. R. Caporn—														
31—36	133	32	223	14	176	2	112	5	180	9	149	42	973	104
L. Rushton—														
37—42	85	66	120	77	43	122	105	45	102	40	190	11	645	361
Mrs. R. Lowe—														
43—48	98	107	153	73	151	47	128	28	163	25	175	15	868	295
R. Lowe—														
49—54	150	13	172	....	151	11	150	26	152	39	104	57	879	146
F. Harris—														
55—60	192	9	143	7	213	3	142	....	120	72	1	6	811	97
D. F. Kashmir—														
61—66	117	8	13	1	142	15	41	1	163	7	107	33	583	65
W. & E. Kerr—														
67—72	147	19	184	2	150	1	95	1	71	....	86	13	733	36
Cranleigh Poultry Farm—														
73—78	12	46	169	11	73	6	187	....	130	5	164	3	735	71
W. G. Hall—														
79—84	205	4	147	....	118	14	187	38	206	10	104	99	967	165
E. Singleton—														
85—90	195	5	179	1	168	5	190	2	127	34	182	6	1041	53
Webb's Hatchery—														
91—96	115	45	256	7	150	25	210	25	176	21	168	35	1075	158
97—102	200	1	138	1	2	3	52	32	174	32	204	34	770	103
R. Harrison—														
103—108	164	2	163	2	215	....	122	19	158	....	169	2	991	25
109—114	210	9	87	72	177	5	86	143	168	1	133	6	861	236
Mrs. E. E. Price—														
115—120	229	1	152	....	162	4	172	2	209	1	140	....	1064	8
E. E. Price—														
121—126	137	....	170	4	131	1	21	39	167	28	81	....	707	72
H. P. Chalmers—														
127—132	127	7	62	19	249	8	210	6	99	....	182	17	929	57
Mrs. M. H. Dadley—														
133—138	166	....	195	1	189	....	175	....	160	1	212	1	1097	3
M. H. Dadley—														
139—144	166	14	159	1	105	....	107	125	70	114	174	20	781	274
Brown Leghorns.														
Runnymede Poultry Farm—														
145—150	127	4	93	52	1	123	113	2	67	60	76	60	477	301

DETAILED RESULTS—*continued.*

SECTION "B" (HEAVY BREEDS)—TEAMS OF SIX BIRDS.

Names of Competitors and Birds Nos.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	Totals. 1st.	Totals. 2nd.
N. T. Wilkinson— 1—6	203	13	250	12	229	....	208	2	161	32	205	3	1256	62
Sundale Poultry Farm— 7—12	135	61	191	21	230	7	190	10	203	1	170	87	1119	187
Thorpe Poultry Farm— 13—18	134	3	204	5	123	....	190	2	188	3	172	5	1011	18
G. E. Robinson— 19—24	168	11	61	16	171	55	164	....	172	91	198	5	934	178
A. R. Caporn— 25—30	126	15	106	52	93	130	190	5	30	104	153	1	698	307
L. Rushton— 31—36	220	2	158	1	181	36	167	1	144	....	150	6	1020	46
F. Harris— 37—42	107	1	56	17	144	8	191	5	129	80	98	121	725	232
W. & E. Kerr— 43—48	241	....	228	5	159	12	174	7	180	7	104	33	1086	64
Cranleigh Poultry Farm— 49—54	112	13	113	1	142	7	133	46	207	....	182	....	889	67
W. G. Hall— 55—60	186	8	191	1	193	3	225	....	131	95	109	88	1035	195
R. Harrison— 61—66	220	2	184	2	243	2	203	2	169	4	212	7	1231	19
R. Knight— 67—72	100	49	140	1	233	12	237	5	233	2	176	28	1219	97
73—78	176	1	174	13	224	11	42	....	115	1	131	....	862	26
Runnymede Poultry Farm— 79—84	231	2	210	....	216	4	175	....	184	4	200	2	1216	12
Mrs. M. H. Dadley— 85—90	221	....	233	....	168	12	52	....	139	4	213	2	1026	18
M. H. Dadley— 91—96	213	27	85	....	35	....	153	2	215	....	159	....	860	29
G. Dolman— 97—102	135	35	248	4	136	78	136	19	122	88	228	3	1005	227
F. Landquist & Son— 103—108	235	....	80	....	247	....	148	10	47	....	186	1	943	11
Mrs. E. E. Price— 109—114	241	7	139	31	36	15	125	1	125	4	230	8	896	66
E. E. Price— 115—120	222	5	113	5	180	107	162	3	222	....	137	1	1036	121
G. Davey & Son— 121—126	199	20	198	....	50	55	104	3	190	7	193	1	934	86
Matt Wall— 127—132	170	60	133	11	179	24	204	14	96	106	200	67	982	282
Runnymede Poultry Farm— 151—156	200	2	84	3	233	....	219	1	217	....	182	...	1135	6
T. Sudell & Son— 157—162	224	58	206	20	162	1	180	....	72	107	201	9	1045	195
A. T. Webb— 163—168	87	8	77	102	155	17	163	15	69	84	74	175	625	401

SECTION "C" (MEDIUM-HEAVY BREEDS)—TEAMS OF SIX BIRDS.

Names of Competitors and Birds Nos.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.	Totals. 1st.	Totals. 2nd.
F. Landquist & Son— 133—138	162	1	....	....	....	....	27	....	70	4	85	3	344	8
G. Dolman— 139—144	114	11	91	12	158	....	109	5	148	....	182	4	802	32
Cranleigh Poultry Farm— 145—150	155	....	147	....	142	7	143	....	196	2	171	1	954	10
Beverley Poultry Farm— 151—156	41	....	136	29	193	15	200	2	103	46	142	40	815	132
Robinson Bros.— 157—162	220	....	176	13	146	43	72	10	212	....	164	10	990	76
R. Miller— 163—168	38	2	131	....	147	2	143	....	48	....	138	....	645	4

Mortality.

	No. of Birds.	Deaths.	Per cent.
White Leghorns	144	9	6·25
Brown Leghorns	6	...	...
Australorps	150	16	10·6
Rhode Island Reds	36	7	19·4

MONTHLY AVERAGES.

Month.	No. of Birds and Breed.	Total No. of 1st Grade Eggs Laid.	Average.	Total No. of 2nd Grade Eggs Laid.	Average.	Average for all Grades.
March (16 days)	144 W.L. ...	492	3·41	303	2·10	5·51
	150 Aus. ...	746	4·97	233	1·55	6·52
	36 R.I.R. ...	172	4·77	5	·13	4·90
	6 B.L. ...	1	·16	...	...	·16
April	144 W.L. ...	1,566	10·87	141	·97	11·84
	150 Aus. ...	2,221	14·80	260	1·73	16·53
	36 R.I.R. ...	337	9·36	9	·25	9·61
	6 B.L. ...	...	...	...	...	...
May	144 W.L. ...	1,506	10·45	198	1·37	11·82
	150 Aus. ...	2,023	13·48	258	1·72	15·20
	36 R.I.R. ...	381	10·58	25	·69	11·27
	6 B.L. ...	...	...	...	...	...
June	144 W.L. ...	1,067	7·40	174	1·20	8·60
	150 Aus. ...	1,564	10·42	279	1·86	12·28
	36 R.I.R. ...	310	8·61	16	·44	9·05
	6 B.L. ...	...	...	...	...	...
July	144 W.L. ...	1,390	9·65	103	·71	10·36
	150 Aus. ...	2,267	15·11	168	1·12	16·23
	36 R.I.R. ...	351	9·75	1	·02	9·77
	6 B.L. ...	14	2·33	23	3·83	6·16
August ...	144 W.L. ...	2,502	17·37	142	·98	18·35
	150 Aus. ...	2,975	19·83	183	1·22	21·05
	35 R.I.R. ...	474	13·54	9	·25	13·79
	6 B.L. ...	102	17·0	28	4·66	21·66
September ...	144 W.L. ...	2,607	18·10	237	1·64	19·74
	150 Aus. ...	2,981	19·87	281	1·87	21·74
	35 R.I.R. ...	552	15·77	14	·4	15·81
	6 B.L. ...	90	15·0	48	8·0	23·0
October ...	144 W.L. ...	2,658	18·45	393	2·72	21·17
	149 Aus. ...	2,822	18·93	331	2·20	21·13
	34 R.I.R. ...	590	17·35	6	·17	17·52
	6 B.L. ...	88	14·66	38	2·29	16·95
November ...	142 W.L. ...	2,331	16·41	389	2·73	19·14
	148 Aus. ...	2,404	16·24	253	1·70	17·94
	34 R.I.R. ...	451	13·26	49	1·44	14·70
	6 B.L. ...	69	11·5	32	5·3	16·8
December ...	140 W.L. ...	2,054	14·64	474	3·38	18·02
	148 Aus. ...	2,069	13·98	338	2·28	16·26
	34 R.I.R. ...	383	11·26	60	1·76	13·02
	6 B.L. ...	60	10·0	57	9·5	19·5

MONTHLY AVERAGES—*continued.*

Month.	No. of Birds and Breed.	Total No. of 1st Grade Eggs Laid.	Average.	Total No. of 2nd Grade Eggs Laid.	Average.	Average for all Grades.
January ...	134 W.L. ...	1,682	12·55	480	3·58	16·13
	141 Aus. ...	1,813	12·85	276	1·96	14·81
	34 R.I.R. ...	369	10·85	43	1·26	12·11
	6 B.L. ...	36	6·0	67	11·16	17·16
February (14 days)	134 W.L. ...	694	5·17	234	1·74	6·91
	141 Aus. ...	804	5·7	94	·6	5·13
	34 R.I.R. ...	180	5·29	25	·73	6·02
	6 B.L. ...	17	2·83	18	3·0	5·83

YEARLY AVERAGES.

	1st Grade.	2nd Grade.	Average All Grades.
White Leghorns	144.71	23.01	167.72
Australorps	166.83	19.94	186.77
Rhode Island Reds	130.0	7.48	137.48
Brown Leghorns	79.5	50.16	129.66

AVERAGE FOR ALL BIRDS IN TEST.

	1st Grade.	2nd Grade.	Total.
All Birds	151.86	20.48	172.34

WINTER TEST RESULTS.

(March 16th to July 31st—138 days.)

Winners.	No. of Eggs.	Average.
Light Breeds—Mrs. M. H. Dadley, White Leghorns ..	480	80
Heavy Breeds—R. Harrison, Australorps	471	78.5
Medium Heavy Breeds—Beverley Poultry Farm, Rhode Island Reds	354	59

LAYING AVERAGES FOR WINTER TEST.

(16th March to 31st July—138 days.)

	1st Grade.	2nd Grade.	All Grades.
White Leghorns	41.81	6.07	47.88
Australorps	52.15	7.97	60.12
Rhode Island Reds	43.08	1.55	44.63
Brown Leghorns	2.5	3.83	5.88

SUMMER TEST.

(1st December to 14th February—76 days.)

Winners.	1st Grade	2nd Grade.
Heavy Breeds—Australorps, Runnymede Poultry Farm ..	283	2

Sections A and C—White Leghorns and Rhode Island Reds: No Award as no team reached 1,200 eggs.

SUMMER TEST—ALL TEAMS.

(1st December to 14th February—76 days.)

	1st Grade.	2nd Grade.	All Grades.
White Leghorns	32.57	8.73	41.30
Australorps	32.76	4.95	37.71
Rhode Island Reds	18.83	23.66	42.49
Brown Leghorns	27.81	3.47	31.28

Comparison of ten leading pens during the last four years—

	1936–37.		1937–38.		1938–39.		1939–40.	
	1st.	2nd.	1st.	2nd.	1st.	2nd.	1st.	2nd.
10 pens White Leghorns ...	960·8	21·7	1,074·6	8·06	1,106·6	54·4	988·9	99·4
10 pens Australorps ...	1,128·6	12·11	1,268·6	7·06	1,181·4	99·9	1,128·1	95·8
6 pens Rhode Island Reds	798·2	220·0	901·2	149·1	902·8	123·0	758·3	43·6

COPPER BANDED BIRDS.

Copper band No.	Trial No.	Breed.	Owner.	No. 1st Grade Eggs.
65	4	White Leghorn	T. Gent	206
66	6	White Leghorn	T. Gent	207
67	9	White Leghorn	R. Knight	214
68	32	White Leghorn	A. R. Caporn	223
69	57	White Leghorn	F. Harris	213
70	79	White Leghorn	W. G. Hall	205
71	83	White Leghorn	W. G. Hall	206
72	92	White Leghorn	W. R. Webb	256
73	94	White Leghorn	W. R. Webb	210
74	97	White Leghorn	W. R. Webb	200
75	102	White Leghorn	W. R. Webb	204
76	105	White Leghorn	R. Harrison	215
77	109	White Leghorn	R. Harrison	210
78	115	White Leghorn	Mrs. E. E. Price ..	229
79	119	White Leghorn	Mrs. E. E. Price ..	209
80	129	White Leghorn	H. P. Chalmer ..	249
81	130	White Leghorn	H. P. Chalmer ..	210
82	138	White Leghorn	Mrs. M. H. Dadley ..	212
159	151	Australorp	E. O. Harrison ..	200
160	153	Australorp	E. O. Harrison ..	233
161	154	Australorp	E. O. Harrison ..	219
162	155	Australorp	E. O. Harrison ..	217
163	157	Australorp	T. Sudell & Son ..	224
164	158	Australorp	T. Sudell & Son ..	206
165	162	Australorp	T. Sudell & Son ..	201
166	1	Australorp	N. T. Wilkinson ..	203
167	2	Australorp	N. T. Wilkinson ..	250
168	3	Australorp	N. T. Wilkinson ..	229
169	4	Australorp	N. T. Wilkinson ..	208
170	6	Australorp	N. T. Wilkinson ..	205
171	9	Australorp	A. Wilkinson ..	230
172	11	Australorp	A. Wilkinson ..	203
173	14	Australorp	H. Seal	204
174	31	Australorp	L. Rushton	220
175	43	Australorp	W. & E. Kerr ..	241
176	44	Australorp	W. & E. Kerr ..	228
177	53	Australorp	S. Dolman	207
178	58	Australorp	W. G. Hall	225
179	61	Australorp	R. Harrison	220
180	63	Australorp	R. Harrison	243
181	64	Australorp	R. Harrison	203
182	66	Australorp	R. Harrison	212
183	69	Australorp	R. Knight	233
184	70	Australorp	R. Knight	237
185	71	Australorp	R. Knight	233
186	75	Australorp	R. Knight	224
187	79	Australorp	E. O. Harrison ..	231
188	80	Australorp	E. O. Harrison ..	210
189	81	Australorp	E. O. Harrison ..	216
190	84	Australorp	E. O. Harrison ..	200
191	85	Australorp	Mrs. M. H. Dadley ..	221
192	86	Australorp	Mrs. M. H. Dadley ..	233
193	90	Australorp	Mrs. M. H. Dadley ..	213

Copper banded Birds—*continued.*

Copper band No.	Trial No.	Breed.	Owner.	No. 1st Grade Eggs.
194	91	Australorp	M. H. Dadley	213
195	95	Australorp	M. H. Dadley	215
196	98	Australorp	Mrs. S. Dolman ..	248
197	102	Australorp	Mrs. S. Dolman ..	228
198	103	Australorp	F. Landquist & Sons ..	235
199	105	Australorp	F. Landquist & Sons ..	247
200	109	Australorp	Mrs. E. E. Price ..	241
201	114	Australorp	Mrs. E. E. Price ..	230
202	115	Australorp	E. E. Price	222
203	119	Australorp	E. E. Price	222
204	130	Australorp	M. Wall	204
205	132	Australorp	M. Wall	200
206	154	Rhode Island Reds	R. Wilson & R. Penton	200
207	157	Rhode Island Reds	Robinson Bros. ..	220
208	161	Rhode Island Reds	Robinson Bros. ..	212

In the above trial 68 birds qualified for copper rings, or 20.54 per cent.

The Champion team was a pen of Australorps entered by N. T. Wilkinson of South Belmont.

The total of 1,256 first grade eggs was 19 eggs lower than the winner of 1938-39.

Mrs. M. H. Dadley of Spearwood won in the White Leghorn section. The team laid 1,097 first grade eggs, this being 164 less than 1938-39.

In the Rhode Island Red section, Robinson Bros. of Belmont won with a team which laid 990 first grade eggs, this being 26 in advance of 1938-39.

Bird No. 87 owned by Mrs. M. H. Dadley laid a sequence of 69 eggs.

FEEDING.

Feed Consumed.	1936–37.	1937–38.	1938–39.	1939–40.
Wheat	190½ bushels	165½ bushels	224¾ bushels	231⅓ bushels
Pollard	186 „	191 „	227½ „	226½ „
Bran	207 „	178 „	224 „	282 „
Wheatmeal ...	6,798 lbs.	6,469 lbs.	8,438 lbs.	9,493 lbs.
Bonemeal ...	747 „	990 „	932 „	1,072 „
Meatmeal ...	1,700 „	1,962 „	2,870 „	3,312 „
	5·14 oz. (per fowl per day)	5·13 oz. (per fowl per day)	5·16 oz. (per fowl per day)	5·16 oz. (per fowl per day)

The cost of feeding for the 48 weeks in the 1939-40 trial was £133 14s. 8d. or equal to 8s. 1d. per bird, while the net average return for eggs was 16s. 3¼d. The average profit was 8s. 2¼d. per bird.

	1936–37.	1937–38.	1938–39.	1939–40.
Cost of Feed	9/9¼	10/3	6/10	8/1
Average Gross Profit ...	8/10	9/2¼	11/8	8/2¼

Note.—Feeding costs are based on the retail prices of all goods as charged by metropolitan produce merchants, whilst the returns for eggs are those received in open sales less 5 per cent. selling commission, and a deduction of an account sales fee of 6d. per sale day (a sum equal to £2 12s. per annum).

Associations for the Improvement of Dairy Herds in Western Australia.

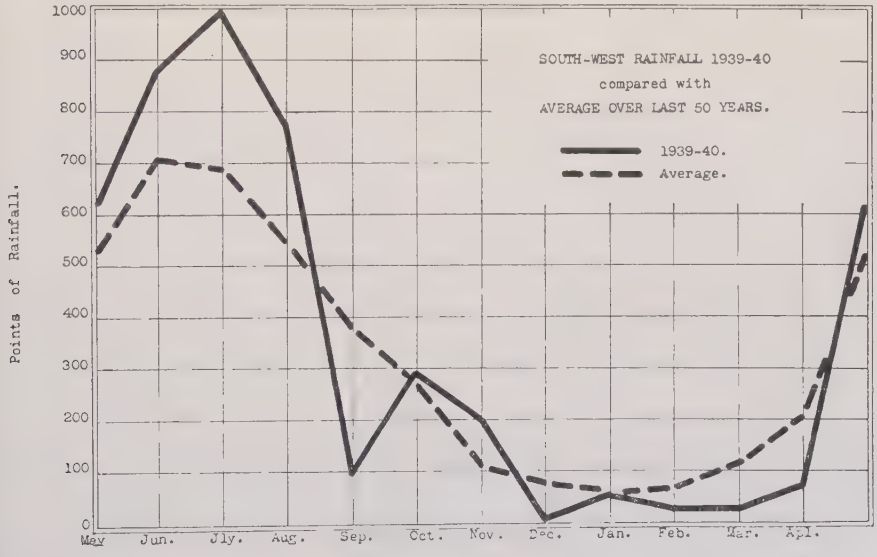
REPORT FOR YEAR ENDING 30th APRIL, 1940.

G. K. Baron-Hay, Superintendent of Dairying.

G. Slater, Recording Officer.

The season 1939-40 was an unfavourable one for the growth of pasture. Rains commenced late in autumn and continued above the normal until the end of August, followed by very few useful registrations during September, thus causing annual pasture plants to form seed prematurely, which prevented their normal growth during October and November. This unfavourable spring was accentuated by lighter falls than normal during succeeding summer months. This is clearly shown in the following figures for rainfall during 1939-40, compared with the average precipitation and in the accompanying graph:—

Year.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total Points.
1939-40	51	25	28	69	617	884	993	771	96	287	201	13	4,035
Average	51	65	109	201	534	701	681	547	379	269	107	73	3,717



The unfavourable season was reflected particularly in the yields of hay and in the conservation of silage, both of which were below the normal.

As would be expected, the production of butterfat during the summer months throughout the State was less than in previous years, although the flush production was approximately equal to that of the previous year.

Another factor which has militated against higher production during the past year has been the unsettled effect on farmers of the outbreak of war, and also the difficulty of obtaining labour through the enlistment of experienced helpers, all of which have tended to reduce average yields.

Table 1 shows the average production of cows under test in the Herd Recording scheme during 1939-40, and includes all cows which were under test for three months or more.

TABLE 1.

AVERAGE PRODUCTION PER COW.

No. of Herds.	No. of Cows.	Milk. lbs.	Test. %	Butterfat. lbs.
465	11,479	4,620	4·51	208·29

The average production of butterfat shows a reduction of approximately 10 lbs. per cow, which may be ascribed almost entirely to the conditions outlined above.

For comparison, the average production per cow since 1933-34—during which year grade herd recording was commenced—is shown in Table 2 below.

TABLE 2.

AVERAGE PRODUCTION PER COW, 1934–1940.

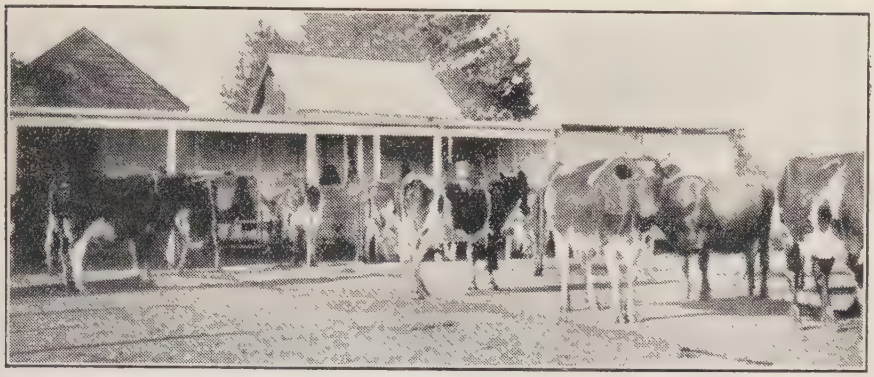
Year.	No. of Cows.	Milk. gals.	Test. %	Butterfat. lbs.
1933–34	4,038	415	4·35	180·6
1934–35	4,088	456	4·56	207·8
1935–36*	4,590	459	4·51	207·3
1936–37†	9,115	434	4·53	196·7
1937–38*	10,033	486	4·59	223·1
1938–39‡	12,368	487	4·48	218·7
1939–40	11,479	462	4·51	208·3

* 1 new Unit. † 9 new Units. ‡ 6 new Units.

No new associations were commenced during the year, and, not only amongst members of associations, but amongst dairy farmers generally, there is a tendency to under-value the importance of maintaining production.

In view of the very special need which has been expressed in Great Britain for the supply of dairy produce, and the special arrangements which are being made for its transit overseas, it is thought that the maintenance of the production of dairy foods can be regarded legitimately as a major effort towards winning the war.

Furthermore, such effort aims at not only increasing yield, but in improving efficiency in production, and is a wise precaution as a safeguard for severe competition during the post war period, not only from other dairying countries, but also from the possibility of the use of substitutes. Therefore, rather than relax efforts at increased and economical production, there is every reason why all means which would ensure this should be adopted, one of the chief of which is grade herd recording.



Plenty of sunlight, concrete floors and marshalling yard, white wash at least once a year.

Production per Cow in each Unit.

The average production per cow in each unit is shown below in Table 3.

TABLE 3.

PRODUCTION PER COW IN EACH UNIT.

Unit.	No. of Herds.	No. of Cows.	Percentage of Heifers.*	Milk.	Test.	Butterfat.	
						1939–40.	1938–39.
				lbs.	%	lbs.	lbs.
A. Donnybrook ...	22	474	32	4,249	4·79	203·30	230·10
B. Serpentine ...	16	368	36	5,397	4·30	232·16	236·90
C. Cookernup ...	21	672	39	5,322	4·46	237·70	252·05
D. Harvey	22	479	34	5,023	4·69	235·52	244·42
E. Brunswick ...	21	597	35	5,371	4·68	251·88	284·37
F. Dardanup ...	21	554	35	4,471	4·48	199·51	216·94
G. Capel	20	841	40	4,799	4·13	198·02	222·18
H. Balingup ...	24	658	34	4,726	4·66	220·37	262·10
I. Forest Grove ...	23	498	27	4,578	4·60	210·96	240·58
J. Pemberton ...	19	354	21	4,740	4·79	227·41	244·76
K. Rosa Brook ...	23	546	30	4,413	4·71	208·07	221·57
L. Vasse	16	367	25	3,844	4·28	159·60	171·91
M. Manjimup ...	24	645	18	4,271	4·42	187·47	209·19
O. Benger	17	472	38	4,923	4·30	214·00	233·67
P. Pinjarra	19	489	47	4,385	4·69	205·67	218·20
Q. Greenbushes ...	18	402	31	4,207	4·62	194·63	222·19
S. Albany	24	491	20	4,968	4·43	220·16	196·83
T. Bridgetown ...	19	533	30	4,075	4·47	182·34	184·76
U. Metricup ...	15	215	9	4,107	4·73	193·90	250·36
V. Ruabon	20	530	29	4,414	4·33	191·13	188·97
W. Northcliffe ...	22	496	27	3,862	4·43	171·29	180·89
X. Cowaramup ...	22	467	30	4,471	4·58	204·94	195·45
Y. Narrogin ...	17	331	56	4,684	4·45	208·20	164·04

* Including cows 2 and 3 years old.

During the year 14 units, embracing 6,896 cows, produced over 200 lbs. butterfat per cow, which yield is considered the lower limit for profitable production.

The Brunswick Unit again filled first place with an average production of 252 lbs. butterfat which, however, is 32 lbs. below the production in the previous year. This is an indication of the difficult conditions which dairy farmers experienced owing to the unfavourable season.

One feature which all these units, except Donnybrook, have in common is that, when herd recording was commenced, the average production of cows was considerably below the 200 lb. mark, which is the minimum regarded as profitable; productions ranging from 160 lbs. butterfat per cow in the Cookernup Unit to 188 lbs. per cow in the Dardanup Unit.

A good-looking cow, but no guarantee of production or persistency.

In the case of the Donnybrook Unit, dairy farming is combined with general mixed farming, including fruit-growing, and the system there has been to calve cows as early as possible in the autumn in order that they may be dried off in January so as not to interfere with the work of picking and packing fruit. Furthermore, the herds in this district were above the average as far as breeding is concerned and mainly of the Jersey breed.

It will be noticed that this unit always has shown productions considerably above the economic minimum, but that the productions have fluctuated up and down from year to year between 220 and 275 lbs. butterfat per cow, and it will be noticed further that in other units the maxima which have been reached are within these same limits.

It is found in practice extremely difficult for whole units embracing 500 to 700 cows to maintain an average production of 250 lbs. butterfat consistently, by reason of the extreme difficulty in obtaining pure-bred bulls with a sufficiently high butterfat backing to increase yields above this figure. This difficulty is shown by reason of the fact that during 1939-40 the average production of all pure-bred cows submitted for official test was approximately 306 lbs. butterfat per cow.

In examining the production records of associations given in Table 3, it is well to remember that all cows which were tested for three months or over during the year are included in these records, and that the actual production of each cow for a full lactation period may be considerably greater than the herd average.

This is shown clearly in Table 4, which has omitted the productions of all cows which did not complete a nine months' testing period, but includes those cows which dried off naturally or for other causes during the year.

Table 4.

PERCENTAGE OF COWS COMPLETING LACTATION.

Unit.	Cows.	Butter Fat.	Unit Average Butter Fat.
	%	lbs.	lbs.
A. Donnybrook	83	211·30	203·30
B. Serpentine	81	240·10	232·16
C. Cookernup	70	274·17	237·70
D. Harvey	85	249·99	235·52
E. Brunswick	72	250·74	251·88
F. Dardanup	57	212·57	199·51
G. Capel	81	203·50	198·02
H. Balingup	88	226·27	220·37
I. Forest Grove	71	234·78	210·96
J. Pemberton	81	236·52	227·41
K. Rosa Brook	55	235·85	208·07
L. Vasse	68	166·00	159·60
M. Manjimup	86	196·44	187·47
O. Benger	96	214·56	214·00
P. Pinjarra	79	224·31	205·76
Q. Greenbushes	93	198·29	194·63
S. Albany	87	239·83	220·16
T. Bridgetown	99	182·40	182·34
U. Metricup	45	246·01	193·90
V. Ruabon	43	219·02	191·13
W. Northcliffe	61	195·82	171·29
X. Cowaramup	70	233·94	204·94
Y. Narrogin	83	220·94	208·20

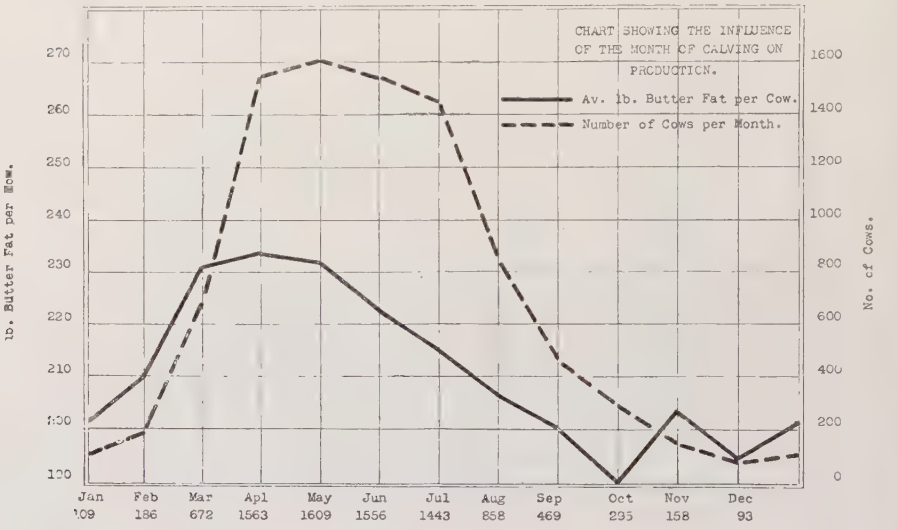
It will be noticed that, where the percentage of cows that calved early in the season is high, it is in those units that the 273-day records approach more closely the unit average. It is obvious that, in order to obtain a nine months' testing period by 30th April in each year, cows should not be submitted for test after the end of July, and during the present year the lesson of the advantage of early calving has been particularly demonstrated in view of the dry summer period.

It is true that higher productions could be obtained by lengthening the lactation period by hand-feeding, but with large herds this may be unprofitable compared with the grazing of cows on natural pasture for a longer period which could be obtained by early calving.

The advantage of the commencement of lactation periods early in the autumn is clearly shown in the attached graph, where it will be seen that cows which calved during the period from March to May produced, on the average, approximately 230 lbs. butterfat, and that cows calving subsequent to May showed a decreasing production to a minimum of under 190 lbs. butterfat in October, and that the average production of cows did not exceed 200 lbs. until lactation periods commenced after December.

In certain units it is necessary to keep as even a production as possible throughout the whole year for a supply of milk to the metropolitan area or for the manufacture of cheese or condensed milk, and it is specially desirable that such a spreading of production throughout the year should be attempted at the present juncture.

From this graph, which is similar to that of previous years, it will be seen that continuity of supply is most profitably obtained by endeavouring to arrange that cows do not calve during the period from October to the middle of January but that the production of milk during this period should be kept up by cows calving not later than September and again early in the new year. At these times of calving, the indications are that cows will produce larger quantities than if they calve during the months of October to December.



Herds grouped according to Production.

In Table 5 the herds in the scheme are grouped according to the average production of butterfat, and the last year's results are compared with the previous year 1938-39 and the first year of testing in 1933-34.

It will be noted that, whereas in the first year of testing (1933-34) nearly three-quarters of the herds under test failed to produce 200 lbs. butterfat per cow, by 1938-39 these low producing herds had been reduced to approximately 30% but that, during the next season, 1939-40, the percentage of herds grouped in the "Under 200 lbs. of Butterfat" class had increased by 11%.

TABLE 5.

HERDS GROUPED ACCORDING TO PRODUCTION.

Year.	Butter Fat per Head. (lb.)							
	Over 400.	350–400.	300–350.	250–300.	200–250.	150–200.	100–150.	Under 100.
	%	%	%	%	%	%	%	%
1933–34	...	...	1·31	3·93	20·30	53·55	18·30	2·61
1938–39	...	·40	7·40	23·30	37·50	25·20	5·80	·40
1939–40	...	...	3·23	18·48	34·62	32·89	9·69	1·08

In view of the fact that new units were not commenced during the year, and herd recorders advised that the quality of cows was considered quite equal to those tested in the previous year, the fall in production could be ascribed fairly to seasonal conditions, particularly as these conditions affected the quantity of fodder conserved.

Fodder reserves are of particular value in a dry season. An excess of requirements should be built up in good years.

It is regretted that no concerted efforts were made by dairy farmers during the past summer to take practical steps to overcome the shortage of conserved fodder which had become apparent by hay-cutting time.

In a number of instances farmers took the precaution of sowing increased areas of summer crops—in some instances—of sowing crops where none at all had been planted for a number of years. In these instances, the acute shortage of hay was not felt so severely and also enabled the hay to be reserved for the autumn months when it would be of most use.

It is not improbable that the present season, which has opened comparatively unfavourably, may be a repetition of the year 1939-40, and it is hoped that all dairy farmers will take the precaution of planting as large an area as possible with a summer fodder such as maize, sorghum, millett, or cow peas, with the view of eking out the hay crops should these be below normal. A review of rainfall records in the past indicate that, if such crops are planted early, it is extremely unlikely that useful returns will not be obtained.

Cows grouped according to Age and Production.

After making due allowance for production according to age, it is found that there is approximately the same percentage of mature cows and junior cows which failed to attain 200 lbs. butterfat during their lactation period.

During the initial years of the scheme it was noted that the production of heifers, after making due allowance for age, was considerably in excess of the

average production of mature cows, which indicated that the breeding policy generally of dairy farmers—namely, the use of a pure bred bull consistently of the one breed—was bearing fruit. As would be expected, however, as the average production of herds increased, there has been an increasing difficulty among farmers in obtaining sires with a sufficiently high "butterfat backing" to improve and—in some instances—to maintain the higher herd averages.

It will be noticed in Table 6 that the percentage of heifers under test is unusually high, approximately 30%, which indicates that farmers have taken the opportunity—whilst meat prices have been high—to cull their herds more severely than normally not only for low production but also for age.

Silage will not deteriorate. Large quantities could have been conserved in year of plenty —1938.

TABLE 6.

COWS GROUPED ACCORDING TO AGE AND PRODUCTION.

(Cows tested less than 90 days excluded.)

Age Class.	Groups according to Butter Fat Production (lb.).								
	Over 600.	500–600.	400–500.	300–400.	200–300.	150–200.	100–150.	Less than 100.	Total Cows.
	%	%	%	%	%	%	%	%	
Mature	...	1	1·2	12·7	46·4	23·0	12·2	4·4	7,813
Junior*	...	·1	·1	4·2	32·6	30·1	23·7	9·2	3,666

*Including cows 2 and 3 years old.

In view of the necessity of increasing production as quickly as possible, it would appear that herds are in a sound position to enable this to be done, as severe culling should not be necessary for several years, particularly as the normal percentage of heifers need not exceed approximately 17% or one heifer for every six

milking cows to maintain the herd at full strength. It is hoped that every effort will be made to increase the numerical strength of herds by more intense farming or by bringing new herds under production.

Table 7.

HIGHEST PRODUCING COW IN EACH UNIT.

Owner.	Unit.	Name of Cow.	Tattoo.	Breed.	Test.	Butter Fat.
					%	lb.
F. Byrd ...	Harvey ...	Chrissie ...	DT 518	Friesian x Jersey	4·61	574·97
R. L. Maidment	Capel ...	Gentle ...	GW 8	Shorthorn x Jersey	5·48	571·28
P. Fitzpatrick ...	Cookernup ...	Darby ...	C9C 47	do.	4·44	561·94
D. Della ...	Pemberton ...	Tiger ...	JN 5	Guernsey x Jersey	5·20	545·17
Narrogin School of Agriculture	Narrogin ...	Cloud ...	YD 6	Ayrshire ...	4·46	540·50
G. S. Blaikie ...	Cowaramup ...	Clue ...	KL 31	Shorthorn ...	3·95	530·53
A. Tomerini ...	Balingup ...	Violet ...	HJ 48	Jersey ...	6·12	520·89
Ellis Bros. ...	Brunswick ...	Jenny ...	EB 10	Jersey x ...	5·74	508·96
F. G. Williams ...	Pinjarra ...	Grannie ...	PM 24	Friesian ...	3·74	508·61
L. Westcott ...	Serpentine ...	Queenie ...	BG 19	Shorthorn x Jersey	6·10	490·18
O. Foan ...	Donnybrook...	Poppy ...	AL 20	Jersey ...	5·11	479·30
W. Darnell ...	Rosa Brook ...	Tiny ...	IU 13	Jersey x Guernsey	6·03	472·44
F. A. Fenning ...	Forest Grove	Sally ...	IN 6	Guernsey ...	5·45	438·83
J. Gilmour ...	Dardanup ...	Seven ...	FE 7	Jersey ...	4·58	429·85
G. Henderson ...	Bridgetown ...	Mintie ...	TH 9	do. ...	5·16	429·41
P. W. Buckeridge	Albany ...	Darkie ...	S⌒ 10	Shorthorn x	4·34	423·25
W. Donaldson ...	Metricup ...	Spot ...	UV 2	Shorthorn ...	4·63	419·10
W. K. Barnes ...	Benger ...	Squib ...	OG 17	do. ...	4·20	415·15
H. G. Letchford	Greenbushes...	Gipsy ...	QX 4	Jersey ...	5·40	394·53
A. J. S. Angel ...	Manjimup ...	Daffodil ...	MZ 7	Guernsey ...	4·13	392·81
F. Oliver ...	Northcliffe ...	Creamy ...	W⊢4	do. ...	4·10	376·05
J. Singleton ...	Ruabon ...	Sybil ...	VY 10	Jersey x Shorthorn	4·99	367·38
R. J. Seymour...	Vasse ...	Fat Brownie	L⌓6	Jersey x	4·52	342·93

In Table 7 the highest producing cow in each unit is shown, the cow "Chrissie" owned by Mr. F. Byrd, Harvey, being the highest producing cow in the scheme with an average production of 574.97 lbs. butterfat.

It will be seen that, although the season has been an unfavourable one, the production of the highest cow in each unit is consistently good, and in no less than nine herds such cows produced over 500 lbs. butterfat during the year.

In Table 8 those herds containing less than 20 cows with an average production of over 280 lbs. butterfat per cow are listed.

It is interesting to note that these herds occur in districts throughout the whole of the South-West and even on the Great Southern and are an indication that, where ample provision has been made for fodder conservation or, in some instances, for the provision of irrigated pasture which takes the place of conserved fodder it is possible to maintain extremely high average productions during one of the severest years experienced in the State.

TABLE 8.

LEADING HERDS OF LESS THAN 20 COWS.

Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lb.
D. Della	Pemberton	14	Guernsey ...	319·85
W. J. Burt	Cowaramup	17	Jersey ...	317·93
R. L. Maidment	Capel	16	Shorthorn ...	316·90
A. Bracknell	Albany	17	do. ...	310·68
W. Donaldson	Metricup	8	...	303·57
J. Fuller	Albany	15	Jersey ...	302·11
E. Booth	Narrogin	18	Shorthorn ...	301·37
O. Foan	Donnybrook	18	Jersey ...	300·06
H. G. Letchford	Greenbushes	16	do. ...	297·86
L. A. House	Pinjarra	18	do. ...	292·67
S. J. Alexander	Cookernup	11	Shorthorn ...	289·30
J. Hill	Cookernup	17	Friesian ...	288·76
Bell Bros.	Brunswick	13	do. ...	287·87
T. Twaddle	Cookernup	19	Jersey ...	287·77
R. Thompson	Pemberton	17	Guernsey ...	286·95
School of Agriculture ...	Narrogin	17	Shorthorn ...	286·90
Mrs. A. G. Eckersley ...	Harvey	18	Jersey ...	286·36
G. W. Marston	Brunswick	18	Shorthorn ...	285·15
J. J. Littlefair	Pemberton	13	Jersey ...	284·26
G. E. Johnston	Rosa Brook	15	...	282·45
P. O'Farrell	Forest Grove	19	do. ...	280·29
C. I. Kasten	Brunswick	16	do. ...	280·03

The following Table 9 gives a list of those herds of from 20 to 40 cows producing more than 290 lbs. butterfat per cow. Two years ago no herds in this group produced over 300 lbs. butterfat per cow, and the owners of the herds in Table 9 are to be congratulated on the average production of these large herds in an unfavourable season.

TABLE 9.

LEADING HERDS OF 20–40 COWS.

Owner.	Unit.	No. of Cows.	Breed.	Butter Fat Average.
				lb.
J. Hartley	Brunswick	35	Jersey ...	345·65
C. P. House	Capel	33	Shorthorn ...	335·31
Mrs. L. R. Barnsby ...	Pemberton	20	Guernsey ...	319·17
P. Fitzpatrick	Cookernup	39	Shorthorn ...	304·53
Ellis Bros.	Brunswick	25	do. ...	302·46
L. M. Temple	Harvey	25	Jersey ...	300·09
A. Miller	Cowaramup	24	do. ...	296·18
R. Hutchinson	Brunswick	27	do. ...	295·81
J. H. Iseppi	Cookernup	31	Jersey x Friesian	293·20
W. B. Blaikie	Cowaramup	25	Jersey ...	292·98

Two interesting points are brought out in the list of high producing herds:—

Firstly: That throughout the Herd Recording Scheme those herds which consistently achieve the highest production are those which are composed either of pure-bred cows or of cows which have been bred consistently to the same breed of carefully selected sires, so that the cows are in appearance and may be regarded genetically as of reasonably pure blood.

This is a policy which has been proved successful in other countries where dairying is of importance; and it is believed that the nearer the herd approaches any one of the pure dairy breeds the higher will be the average production, and that with a crossbred herd, although high production may be obtained for one or two years, there is extreme difficulty and certainly an element of luck in maintaining this high yield.

Secondly: That in any list of herds of less than 20 cows there is ample representation from districts south of Bridgetown and Busselton, that is, in the comparatively recently developed areas. However, in the herds of larger numbers, exceeding 20, the representation of such districts is small and almost non-existent where herds exceed 40 in number.

It is apparent that the majority of dairy farmers in the extreme South-West are not increasing the size of their herds as rapidly as might be expected, particularly in view of the good prices that have been ruling for butterfat for several years.

It is thought sound that the present should be regarded as a favourable time to use every effort to bring new ground into production—or by other means increase the size of herds—not only because there is a demand for dairy produce, but because this is one of the best means whereby dairy farmers may prepare themselves for any post-war fall in prices.

In Table 10 appears a list of herds of over 40 cows with an average production of more than 230 lbs. butterfat per cow.

TABLE 10.

LEADING HERDS OF OVER 40 COWS.

Owner.	Unit.	No. of Cows.	Breed.	Butterfat Average.
				lb.
A. Tomerini	Balingup	41	Jersey ...	319·42
W. K. Barnes	Benger	44	Shorthorn ...	289·78
J. Salerian	Cookernup	79	Jersey ...	286·15
Mrs. D. B. Rose	Brunswick	53	do. ...	275·27
G. W. Payne & Sons ...	Capel	53	Ayrshire ...	269·47
D. Scott	Balingup	48	Jersey ...	262·33
K. Prowse	Capel	45	do. ...	245·10
S. H. Fry	Benger	43	Shorthorn ...	243·56
W. Atkins	Dardanup	48	Jersey ...	239·15
Mrs. C. M. Corker	Harvey	44	do. ...	239·14

The average productions of the herds given in Tables 8, 9, and 10 should be pondered over carefully by owners of pure-bred herds which have been submitted for test during the past season.

Preparations should be made to sow large areas with maize this spring.

Sorghum is a prolific summer crop, and if sown thickly will provide dry roughage for the winter months.

It will be apparent that there are very few pure-bred herds in the State which can supply bulls in any numbers with ancestry having sufficiently high butterfat production records to increase the average productions of some of the herds being tested in the Grade Herd Recording Scheme.

Although the number of pure-bred cows under test may be a small percentage of cows in the State, stud breeders hold one of the "key" positions for the successful development of the dairying industry and for the planning of any scheme aimed at a reduction in the costs of production. This is realised by the committees of management of the three principal dairy breeds, who during the last few years have taken steps to endeavour to prevent the registration of stock which are considered untrue to type; but, in order to achieve practical results, just as great an effort should be made to ensure that the average productions of these breeds should be raised also in order to fill the needs of such herds as are listed in the three Tables Nos. 8, 9, and 10.

"Proved" Bulls.

Following the practice which was commenced in 1936-37, a further list of "proved" pure-bred bulls having six or more daughters that have been tested and have produced over 200 lbs. butterfat per cow has been compiled and is given below in Table 11.

TABLE 11.

ADDITIONAL LIST OF BULLS HAVING SIX OR MORE DAUGHTERS AVERAGING OVER 200 LBS. BUTTERFAT.

Name of Bull	No. of Daughters Averaged.	Average Butterfat Production.	Unit.	Owner or Late Owner.	Age of Bull.
Australian Illawarra Shorthorn—					
Kaleula Gold Digger	13	290	Capel ...	C. P. House ...	9
Maxicar Paul ...	11	310	Brunswick ...	J. Hartley ...	7
Starlight of Wongong	29	256	Albany ...	F. Pease ...	...
Telyarup Bill ...	8	221	Manjimup ...	W. Hamilton ...	Dead
Widgee Waa Record	23	223	Brunswick ...	C. L. Clarke & Co.	10
Wooroloo Bruce ...	10	210	Balingup ...	R. T. Meade ...	6
Ayrshire—					
Creamy Prince ...	6	291	Dardanup ...	T. P. Harris ...	4
Denbeigh Maxine's Manxman	23	257	Capel ...	G. W. Payne ...	9
Tipperary Moonlight	6	299	Dardanup ...	T. P. Harris ...	...

TABLE 11—*continued.*

ADDITIONAL LIST OF BULLS HAVING SIX OR MORE DAUGHTERS AVERAGING OVER 200 LBS. BUTTER FAT—*continued.*

Name of Bull.	No. of Daughters Averaged.	Average Butter-fat Production.	Unit.	Owner or Late Owner.	Age of Bull.
Friesian—					
Cadalelup Plus Patch	10	242	Serpentine ...	G. Bett	7
Chittering Korndyke Veeman	11	299	Harvey ...	F. Byrd	Dead
Dunmore Bountilad	7	255	Serpentine ...	W. Taylor ...	7
Guernsey—					
Drakesbrook Baron...	10	296	Balingup ...	M. Brennan ...	8
Koojan Cherub ...	8	229	Manjimup ...	G. Braid ...	Dead
Lansdowne Radiant Chief	7	268	Narrogin ...	T. H. James ...	Dead
Muresk Minos ...	6	256	Manjimup ...	M. Kilrain ...	Dead
Newry Lad	6	260	Narrogin ...	S. M. Butcher ...	11
Rosewood Melody Chief	6	219	Pemberton ...	M. Humphry ...	13
Wollongbar Comet ...	10	238	Manjimup ...	H. Brown ...	Dead
Wollongbar Justice...	10	264	do. ...	A. J. S. Angel ...	Dead
Jersey—					
Brookvale Reward ...	12	202	Balingup ...	G. C. White ...	6
Burekup Laddie ...	18	203	Greenbushes...	E. G. Pollard ...	Dead
Colmyn Cyclone ...	15	329	Cookernup ...	J. Salerian ...	...
Colmyn Victor ...	12	286	Cowaramup ...	M. J. Walter ...	4
Devonia Bing Boy ...	7	232	Pinjarra ...	L. A. House ...	Dead
Eastbrook Tribute ...	6	287	Pemberton ...	D. Della ...	Dead
Fascinator of Juadine	12	291	Donnybrook...	G. Layman ...	Dead
Garden Hill Paymaster	6	268	Ruabon ...	H. Semmens ...	Dead
Glen Royal	7	289	Donnybrook...	O. Foan	Dead
Grantham Air Prince	9	296	do. ...	A. C. Frost ...	8
Grass Vale King Twylish	13	254	Brunswick ...	A. F. Clifton & Co.	6
Grass Vale Montrose Twylish	11	269	do. ...	R. A. Clifton ...	Dead
Greenmount Snowstorm	10	236	Pinjarra ...	J. Davidson ...	5
Jock of Australind ...	13	211	Bridgetown ...	J. Sparks ...	Dead
Juadine Robin ...	9	252	Narrogin ...	E. Loynel ...	7
Larry of Juadine ...	9	262	Bridgetown ...	J. Sparks ...	Dead
Leo of Applegrove ...	7	204	Northcliffe ...	C. H. Collins ...	9
Mereworth Belvedere Starbright	8	212	Balingup ...	Mrs. H. K. Ellis	6
Mokine Samson ...	6	223	Manjimup ...	J. W. Marqueson	Dead
Mokine Hercules ...	6	241	Bridgetown ...	J. Collins ...	11
Nooka King Ragtime	8	303	Narrogin ...	E. Loynel ...	10
Silver Knight of Trelawney	6	280	Ruabon ...	C. W. Casselton	Dead
Tap of Leithvale ...	10	203	Manjimup ...	Young & Emery	9
Tavistock Silver Prince	10	253	Rosa Brook ...	J. P. Smith ...	11
Thurgoona Seaplane	9	266	do.	H. Pickering ...	10

During the previous three years the names of 145 bulls and the average production of their daughters, together with the names of the owners of these bulls where such are known, were published, and the present list contains the names of a further 45 "proved" sires.

Average Production of all Units.

Particulars of the production of the herds in all units which were under test during 1939-40 are appended hereunder.

Donnybrook "A."	No. of Cows.	Butter Fat Average. lbs.
O. Foan "L"	18	300·06
A. C. Frost "C" ...	17	272·16
W. J. Sears "A" ...	30	263·50
Herd U	30	244·49
„ G*	17	243·17
„ F*	20	240·43
„ K	13	235·40
„ E	20	230·92
„ RA	12	224·21
„ C	12	217·92
„ —A	21	183·56
„ D	43	182·42
„ RX	30	181·57
„ RJ*	11	179·91
„ —B	35	174·99
„ E	35	172·89
„ C*	21	171·53
„ RY	10	170·89
„ RR	13	167·24
„ X	32	167·17
„ A*	20	162·80
„ RP	14	119·94

Serpentine "B."	No. of Cows.	Butter Fat Average. lbs.
L. Westcott "G" ...	25	289·27
G. Scott "U"	14	264·19
R. H. Briggs "V" ...	12	260·63
Herd R	28	249·72
„ D*	22	245·60
„ Y	12	244·97
„ L	9	244·26
„ T	37	233·85
„ X	17	227·64
„ M	11	227·48
„ S	29	227·31
„ A	66	225·08
„ O	37	211·15
„ H	26	206·54
„ N	14	188·48
„ C	9	172·30

* Letter reversed.

Cookernup "C."	No. of Cows.	Butter Fat Average. lbs.
P. Fitzpatrick "9C" ...	39	304·53
J. H. Iseppi "F"‡ ...	31	293·30
S. J. Alexander "R" ...	11	289·30
Herd P	17	288·76
„ J‡	20	287·77
„ CS	79	286·15
„ Y	15	275·47
„ 2C	10	273·69
„ K‡	26	268·95
„ E‡	22	264·37
„ T	20	263·24
„ L	31	236·05
„ F	63	230·32
„ D	22	215·70
„ Z	21	214·48
„ Y‡	45	211·80
„ Q‡	36	203·93
„ 7C	61	202·14
„ V	52	194·10
„ J	30	184·82
„ 6C	20	171·43

Harvey "D."	No. of Cows.	Butter Fat Average. lbs.
L. M. Temple "C" ...	25	300·09
Mrs. A. G. Eckersley "E"	18	286·36
E. J. Manning "NH" ...	25	284·06
Herd E*	23	255·59
„ NM	20	252·01
„ F*	15	246·59
„ A†	25	244·46
„ T	30	241·29
„ B	23	241·11
„ CC	44	239·14
„ CE	19	237·86
„ AD	29	235·20
„ NB	14	228·49
„ AC	32	220·51
„ L*	18	215·48
„ AG	14	208·34
„ AN	14	204·61
„ G*	19	202·51
„ CA	13	198·69
„ NT	18	193·86
„ G	35	193·78
„ J*§	6	176·79

* Letter reversed. † Tested 8 months only. ‡ Letter inverted. § Tested 5 months only.

Average Production of all Units—continued.

Brunswick "E."	No. of Cows.	Butter Fat Average. lbs.
J. Hartley "M" * ...	35	345·65
Ellis Bros. "B" ...	25	302·46
R. Hutchinson "R" * ...	27	295·81
Herd P*	13	287·87
„ A*	25	287·03
„ E*	18	285·15
„ Q	31	283·64
„ C*	38	283·19
„ D	16	280·03
„ B*	53	275·27
„ A	35	257·87
„ T*	18	257·07
„ V*	19	252·26
„ H	31	252·20
„ U	39	232·46
„ Q*	20	220·69
„ K*	31	213·75
„ E	39	201·67
„ L*	23	197·70
„ U*	20	172·14
„ S*	41	141·25

* Letter reversed

Dardanup "F."	No. of Cows.	Butter Fat Average. lbs.
J. Gilmour "E" ...	24	290·29
D. Strachan "C" ...	23	272·72
W. Anderson "A† R†"	10	260·63
Herd A† E†	26	254·36
„ I	16	250·94
„ 5	20	243·59
„ D	48	239·15
„ M	20	229·72
„ A† N	23	226·69
„ A† T	14	218·49
„ A	19	207·32
„ A† W	31	190·40
„ K	43	183·87
„ A† K†	15	173·62
„ A† V	44	166·11
„ A† P	31	161·80
„ A† M†	43	156·99
„ A† M	26	156·07
„ A† U	22	153·60
„ A† D†	37	151·96
„ A† C†	19	123·77

† Letter inverted.

Capel "G."	No. of Cows.	Butter Fat Average. lbs.
C. P. House "D" ...	33	335·31
R. L. Maidment "W"	16	316·90
G. W. Payne & Son "X"	53	269·47
Herd A*	45	245·10
„ I	52	213·47
„ M	39	213·30
„ A	64	211·84
„ B‡	30	205·76
„ C	30	204·31
„ N	31	199·26
„ V	54	184·06
„ Z	57	181·16
„ E	45	180·98
„ J	35	175·30
„ Q	37	173·41
„ B	53	157·93
„ C‡	37	155·28
„ R	42	146·73
„ D‡	69	145·32
„ O	19	144·11

Balingup "H."	No. of Cows.	Butter Fat Average. lbs.
A. Tomerini "J" ...	41	319·42
A. M. Brazier "A" * ...	30	279·79
Mrs. H. K. Ellis "N" ...	25	270·46
Herd S	30	268·63
„ R	21	266·85
„ K	48	262·33
„ Y	17	256·82
„ F†	39	255·54
„ H9	20	245·52
„ Q	18	212·29
„ D†	15	211·98
„ P	22	211·38
„ K†	48	208·72
„ C	48	203·56
„ G†	47	202·49
„ E	22	193·02
„ H3	10	185·98
„ B†	32	170·20
„ H4	27	168·23
„ L§	24	158·79
„ D	18	157·22
„ J†	22	145·24
„ H5	31	145·22
„ F	10	142·11

* Letter inverted. † Letter reversed. ‡ Letter inverted. § Tested 5 months only.

Average Production of all Units—continued.

Forest Grove "I."	No. of Cows.	Butter Fat Average. lbs.
H. Eddy "U" ...	30	281·21
T. A. Fenning "N" ...	33	280·92
P. O'Farrell "L"* ...	19	280·29
Herd F‡	27	280·16
„ V	12	256·31
Z	23	230·01
„ T‡	20	228·95
„ T	17	228·41
„ J‡	26	223·02
„ G‡	11	206·73
„ WB	17	205·76
„ C	17	205·36
„ BB	20	203·64
„ W‡	21	190·04
„ D*	16	185·76
„ Q‡	27	179·73
„ E	16	179·02
„ D	39	173·95
„ K*	22	173·22
„ E*	28	171·22
„ V‡	19	159·26
„ A‡	23	144·09
„ AB	15	142·93

Pemberton "J."	No. of Cows.	Butter Fat Average. lbs.
D. Della "N"	14	319·85
Mrs. L. R. Barnsby "B"	20	319·17
R. Thompson "AF" ...	17	286·95
Herd G	13	284·26
„ U	19	275·61
„ AB	16	255·77
„ V	15	250·52
„ L	15	235·18
„ T	7	233·83
„ H	11	233·28
„ F	24	232·85
„ A	17	232·15
„ R	22	231·17
„ Y	19	224·95
„ P	12	208·98
„ O	12	207·96
„ Z	17	203·59
„ AE	10	202·83
„ D	23	189·33
„ AD§	21	149·03
„ X...	12	128·06
„ AC‡	18	113·55

* Letter reversed. ‡ Letter inverted. § Tested 9 months only. ‡ Tested 7 months only.

Rosa Brook "K."	No. of Cows.	Butter Fat Average. lbs.
N. Ranson "A" ...	32	284·34
G. E. Johnston "T"*...	15	282·45
T. C. Minchin "Y"* ...	20	266·25
Herd Q	19	265·76
„ E	19	245·97
„ F*	13	242·45
„ U	29	234·77
„ P	14	231·00
„ J*	18	218·96
„ B	27	214·21
„ R*	37	212·27
„ E*	31	210·94
„ G*	24	195·60
„ Z	20	191·18
„ C	16	190·43
„ H...	44	187·46
„ B*	31	184·93
„ W	17	184·46
„ A*	16	178·66
„ F	27	173·46
„ D	24	166·79
„ G	23	160·23
„ D*	30	133·32

Vasse "L."	No. of Cows.	Butter Fat Average. lbs.
D. H. Bell "Z" ...	9	259·40
R. J. Seymour "P"†...	24	228·02
M. and I. Drakes "A"†	12	217·85
Herd C	29	203·98
„ H	29	199·77
„ N†	34	179·26
„ X	16	175·64
„ U†	21	174·10
„ M†	23	167·06
„ G†	12	143·68
„ S†	29	139·51
„ R†	24	126·54
„ Y	48	117·97
„ O	45	105·51
„ J†‖	2	86·22
„ F†‖	10	65·07

* Letter inverted. † Letter "lazy." ‖ Tested 3 months only.

Average Production of all Units—continued.

Manjimup "M."	No. of Cows.	Butter Fat Average. lbs.
C. I. Doust "A" ...	27	268·33
A. R. Jones "V" ...	7	257·38
A. J. S. Angel "Z" ...	29	242·41
Herd H	14	235·73
„ Q	15	229·40
„ I	14	227·63
„ C	25	223·51
„ B*	27	219·01
„ D*	29	216·94
„ N	17	212·87
„ R*	16	202·95
„ D	19	201·66
„ B	28	198·92
„ M	38	196·47
„ P	62	191·35
„ E	20	186·15
„ A†	41	186·15
„ W	20	175·14
„ J	19	170·92
„ E*	27	162·70
„ T	32	156·38
„ R	30	154·07
„ K*	14	141·08
„ O	38	116·71
„ Y	38	112·51

Benger "O."	No. of Cows.	Butter Fat Average. lbs.
W. K. Barnes "G" ...	44	289·78
T. B. Stanley "M" ...	18	258·19
S. H. Fry "A" † ...	43	243·56
Herd L	38	242·06
„ AD	17	241·12
„ Y	17	221·30
„ AF	18	217·48
„ D	21	214·21
„ J	37	213·07
„ AE	15	194·27
„ AJ	24	188·09
„ AB	41	185·72
„ X	29	182·76
„ AC	16	177·21
„ S	41	174·57
„ T	35	174·11
„ C	18	130·73

* Letter reversed. † Letter inverted.

Pinjarra "P."	No. of Cows.	Butter Fat Average. lbs.
L. A. House "L" ...	18	292·67
J. Davidson "A" † ...	31	267·92
F. G. Williams "M" ...	26	260·67
Herd B*	12	259·02
„ J	23	252·21
„ B	36	233·72
„ A	45	230·42
„ N	27	228·19
„ U	30	226·02
„ V	22	209·29
„ F	20	205·79
„ D*	30	204·04
„ AB	18	201·36
„ G	38	200·04
„ E*	26	177·97
„ C	28	176·92
„ K	26	134·99
„ T	55	108·90
„ F*	9	95·70

Greenbushes "Q."	No. of Cows.	Butter Fat Average. lbs.
H. G. Letchford "X" ...	16	297·86
T. Giblett "P" † ...	12	269·06
W. Taylor "U" ...	15	265·45
Herd C	34	226·11
„ Q	18	211·34
„ J†	21	208·84
„ G	28	204·49
„ E	14	203·72
„ Z	59	193·77
„ P	33	185·60
„ Y†	14	181·22
„ I	29	178·93
„ V†	18	171·29
„ B	20	166·25
„ V	34	160·39
„ T†	12	159·16
„ J	16	134·23
„ L	9	75·61

* Letter reversed. † Letter inverted.

Average Production of all Units—continued.

Albany "S."	No. of Cows.	Butter Fat Average.
		lbs.
A. Bracknell "A" ‡ ...	17	310·68
J. Fuller "E" * ...	15	302·11
J. Woods "Z" * ...	11	277·96
Herd Q‡	14	277·10
„ F	10	262·73
„ M‡	26	260·89
„ L	35	255·71
„ G*	14	252·76
„ B	22	240·36
„ F*	18	223·25
„ U‡	16	222·13
„ J	13	220·71
„ V‡	34	218·21
„ E	19	212·36
„ Y	16	205·01
„ I	27	203·91
„ B*	21	202·17
„ K*	19	201·87
„ P*	27	194·70
„ C*	26	191·51
„ D*	25	185·16
„ R	14	183·79
„ X	24	182·38
„ T	28	110·97

Bridgetown "T."	No. of Cows.	Butter Fat Average.
		lbs.
G. Henderson "H" ...	23	268·27
W. Watson "C" ...	16	230·75
G. Dixon "K" ...	22	216·81
Herd I	42	210·98
„ J	23	208·82
„ A	46	208·41
„ Y	29	192·24
„ S	16	190·90
„ Q	39	182·97
„ D	44	178·97
„ G	29	177·27
„ E	31	169·44
„ X	29	169·23
„ N	32	153·06
„ B*	17	148·50
„ M	30	144·66
„ Z	19	136·32
„ U	28	130·31
„ F	18	129·51

‡ Letter inverted. * Letter reversed.

Metricup "U."	No. of Cows.	Butter Fat Average.
		lbs.
W. Donaldson "V" ...	8	303·57
R. Hart "L"	10	250·41
W. F. Webster "N" ...	28	245·65
Herd Q	20	233·34
„ B	24	224·15
„ T	11	219·77
„ M	15	198·44
„ Z	18	181·57
„ F	15	179·88
„ X	19	178·82
„ I	6	125·98
„ Y	14	120·72
„ A	7	112·64
„ G	11	103·69
„ O	9	77·54

Ruabon "V."	No. of Cows.	Butter Fat Average.
		lbs.
W. Casselton "F" * ...	15	261·69
J. Singleton "Y" ...	14	239·53
H. Semmens "X" ...	42	238·23
Herd K	30	228·52
„ H	30	223·42
„ D	9	219·67
„ N	30	216·15
„ P*	27	211·71
„ F	32	196·21
„ O	18	178·25
„ R	22	176·28
„ B	44	172·21
„ L	20	171·98
„ S	36	171·06
„ E	23	169·05
„ T	33	164·23
„ V	45	163·36
„ Z	17	162·38
„ A	30	154·78
„ B*	13	128·84

* Letter reversed.

Average Production of all Units—continued.

Northcliffe "W."	No. of Cows.	Butter Fat Average. lbs.	Cowaramup "X."	No. of Cows.	Butter Fat Average. lbs.
G. R. Pratt "B" ...	21	242·53	W. J. Burt "H" ...	17	317·93
F. Oliver "I"* ...	19	216·40	A. Miller "KM" ...	24	296·18
J. Daubney "D"* ...	23	216·02	W. B. Blaikie "A" ...	25	292·98
Herd M	24	211·75	Herd C	17	253·01
„ J	28	202·11	„ KI	21	251·10
„ H	16	201·18	„ KL	17	237·35
„ C	26	191·14	„ N	14	233·66
„ F	28	184·94	„ I	24	223·35
„ N*	26	181·57	„ K	20	212·54
„ Z	23	179·04	„ R	20	203·69
„ U	36	171·34	„ E	13	199·23
„ P	21	169·43	„ X	19	198·32
„ L	12	166·24	„ O	21	191·75
„ O	23	165·70	„ D	24	190·24
„ G	34	165·40	„ T	21	188·12
„ T	16	136·70	„ F	29	187·46
„ R	18	131·21	„ G	17	186·11
„ K	22	123·63	„ KY	22	179·05
„ S	21	121·65	„ Y	24	166·75
„ V	15	121·50	„ P	16	160·18
„ X†	27	117·17	„ L	35	157·05
„ E‡	17	109·69	„ KJ	27	150·50

* Letter "lazy." † Tested 7 months only. ‡ Tested 9 months only.

Narrogin "Y."	No. of Cows.	Butter Fat Average. lbs.
E. Booth "E" ...	18	301·37
Narrogin School of Agriculture "D"	17	286·90
H. Trefort "F" ...	12	259·59
Herd H	13	258·94
„ I	11	256·66
„ B	64	229·29
„ N	24	206·66
„ A	45	198·50
„ C	10	192·85
„ G	19	183·64
„ O	12	179·15
„ K	14	171·98
„ L	13	154·44
„ J	16	150·95
„ Q	10	150·50
„ P	14	147·34
„ M	19	146·07

Sires of the Farmer's Flock.

By Hugh McCallum, Sheep and Wool Adviser.

The foundation of the flock is laid by the selection of a good even line of ewes —preferably a registered breeder's "cast for-age" line, which sheep have been carefully selected over a period of years and have been the mothers of the breeding flock—and the future success is influenced by the adoption of correct methods of husbandry, but the keystone around which the flock will be built up is represented by the rams—the sires who will leave their mark on the sheep of future generations. It is with these "grand old men" of the sheep world that this article will deal.

No matter what the ultimate object may be, the production of wool or export lambs, its achievement depends greatly on the rams provided. Just "male sheep" are a matter of easy obtaining, but "sires" need to be carefully considered, inspected and selected. Whatever the breed, only pure-bred rams should be used.

The flock owner must mentally picture the type of sheep he desires to breed up to and thereafter must cull, mate and select to attain that type, correcting defects and improving quality each season. There is no short cut in breeding that will give satisfactory results and the ideal can only be obtained by systematic breeding gradually fixing the desired characteristics. Too frequently the sheep owner attempts to quickly improve his flock by the purchase of rams, often very high grade animals, regardless of their suitability for mating with his ewes, and then is most disappointed with the progeny. The ram is too important a factor and has too great an influence to be introduced into the flock without first being carefully considered as to type and subjected to a rigid and thorough examination. The outward appearance may be attractive, but the wool is often a deceiving factor and close inspection will reveal many defects in constitution and conformation not discernible at first glance. If possible, an inspection soon after shearing and again when the animals are in full wool, is a wise plan.

It must be ever remembered that the first essential in building up a flock is constitution, and given this, other attributes to a good ram are masculinity; bold appearance; well-shaped and well-carried head; good squarely set jaw with solid even teeth; bright eyes; strong frame with straight back; well-sprung ribs; plenty of width across the shoulders; deep girth, giving heart and lungs plenty of room; wide chest; well-set on, sturdy legs, with strong healthy hooves; a good carriage with a free walk. A big-boned animal is preferable as thin-boned and cow-hocked or knock-kneed rams are usually poor walkers and should be avoided.

A flock man who has not been associated with sheep long enough to enable him to visualise his breeding objective should seek the advice of an experienced sheepman regarding the best lines to work on to effect permanent improvement and he is well-advised to purchase his rams annually from a reliable registered breeder.

The value of the registered breeders in the industry is now always fully realised and appreciated by the newer flock man. It enables owners to purchase sires and at the same time indirectly gives them valuable assistance in assuring that such sires have behind them the characteristics desired and the power to impart them, thus giving the owner the benefit of the knowledge gained in the life-long study of sheep by well-experienced men. Again, there is an assurance of sound constitution in such rams and this quality of fundamental importance is largely the product of hereditary influence which the stud breeder has

developed by years of careful culling, mating and selection. Another aspect of the advantage the registered breeder affords is that the register of stud flocks, which is issued annually by the central organisation of stud breeders throughout the Commonwealth, enables the new flock owner to select and purchase from a breeder whose stock are of a blood strain akin to that to which his foundation ewes belong.

When once satisfactory rams have been obtained it is wiser for the flock owner to purchase his annual draft of rams from the same breeder, than to change from blood to blood. This enables him on every occasion to select sires that are particularly outstanding in any characteristic where the ewes show weakness and to be sure that the mating will be satisfactory.

From mating to mating the rams must be cared for. The average mortality in rams is generally higher than it should be and the percentage of efficient rams at mating season could be greatly increased by the regular and careful inspection of sires. Immediately after they are removed from the ewes, they should be yarded and examined individually to see that no damage has been sustained while at work and any small injuries should be dressed. At all seasons of the year rams will fight, and broken places, about the head in particular, are very apt to get fly-blown if not dressed. Lack of attention will result in the undermining of the animal's health and probably mean a poor lambing percentage. Throughout the year the animals must be paddocked where there is good feed and ample water supply, and some months prior to mating special care must be taken to assure that the animals are in the best of condition and full of vigour, though, of course, not over-fat and lazy.

Good foundation ewes, correct husbandry measures and the selection of high class suitable rams, cannot but build up successfully the flock of any sheepman.

The Official Australian Pure Bred Dairy Cattle Production Recording Scheme.

G. K. Baron-Hay (Superintendent of Dairying) and G. Slater (Recording Officer).

In preparing the following tables showing the results of Pure Breeds Herd Testing for the year ended 30th June, 1940, it was anticipated that the effect of the unfavourable season during 1939 would be reflected in production, but this is not the case, as the 382 cows under review yielded an average of 6,629 lb. of milk at 4.61 per cent. test, equal to 305.88 lb. of butter fat without age allowances, the highest average since the year 1934-35. Twenty-five cows which were tested less than 150 days and were withdrawn owing to sickness or sale, have not been included in any of the averages, although their productions are recorded in Table 3.

The number of cows passing the various standards remains fairly constant from year to year and, as will be seen in Table 1, the Guernsey breed, though numerically weak, has maintained its position with the highest percentage of passes. The Jerseys, which suffered a marked decline a few years ago, have improved considerably, while the Shorthorns have dropped below the average, mainly as the result of poor yields in the three-year-old classes.

Similar low productions in these classes were evident last year, and it is thought that the tendency to bring heifers of this breed into profit too early may affect the yield during the second and third lactations. In fact, the records of some cows indicate that the strain of early calving is not completely overcome until maturity,

and this may account to some extent for the comparatively poor productions recorded by Messrs. D. Bevan & Son's "Blacklands Ettie 9th" before making her State record yield of 776.91 lb. butter fat this year.

TABLE 1.
COWS PASSING STANDARD.

Age Class.	A.I.S.		Guernsey.		Jersey.		All Breeds.	
	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.	No. of Cows Tested.	No. Passing Standard.
Mature	51	20	22	16	39	18	112	54
Senior 4 years ...	3	1	4	2	10	3	17	6
Junior 4 ,, ...	17	12	9	7	12	8	38	27
Senior 3 ,, ...	20	6	2	2	15	10	37	18
Junior 3 ,, ...	16	6	10	8	11	9	37	23
Senior 2 ,, ...	30	15	4	4	17	14	51	33
Junior 2 ,, ...	40	25	20	16	30	24	90	65
Totals ...	177	85	71	55	134	86	382	226
Per cent. Passing Standard ...	48·0		77·5		64·2		59·2	

For the third year in succession the Champion Herd Sire was the well-known imported Guernsey bull "Homestead Ace" (1631) owned by Mr. A. W. Padbury of Koojan, his leading six daughters averaging 515.94 lb. butterfat, or with age allowances, 555.36 lb. Among the daughters was "Koojan Ace's Jewel II." which, during the year, yielded an Australian record for a junior 4-year-old Guernsey cow of 683.45 lb. butter fat in 273 days.

TABLE 2.
AVERAGE BUTTER FAT PRODUCTION IN EACH CLASS.

Age Class.	A.I.S.		Guernsey.		Jersey.		All Breeds.	
	No. of Cows.	Average Butter Fat.	No. of Cows.	Average Butter Fat.	No. of Cows.	Average Butter Fat.	No. of Cows.	Average Butter Fat.
		lb.		lb.		lb.		lb.
Mature	51	348·67	22	408·24	39	324·02	112	351·79
Senior 4 years ...	3	313·67	4	328·83	10	317·45	17	319·46
Junior 4 ,, ...	17	363·90	9	398·00	12	340·60	38	364·62
Senior 3 ,, ...	20	271·84	2	331·08	15	332·04	37	299·45
Junior 3 ,, ...	16	253·13	10	284·68	11	328·39	37	284·03
Senior 2 ,, ...	30	254·91	4	349·94	17	282·91	51	271·70
Junior 2 ,, ...	40	243·66	20	263·10	30	256·81	90	252·36

Table 2 discloses how seasonal conditions, mammitis and other complaints, and the difficulty of successfully mating cows at the desired time, all tend to lower production in the older classes as many of the animals now figuring as mature cows, and only just passing the standard, have exceeded the standard by a considerable margin in previous lactations. The mature Jersey cows are well below the average, but as the productions of this breed in the younger sections have shown a marked improvement over the last few years, it can be expected that the standard for mature cows will gradually rise.

TABLE III.

COWS WHICH COMPLETED TEST DURING THE TWELVE MONTHS ENDED 30TH JUNE, 1940.

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for Last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS UNDER 2½ YEARS—STANDARD 230 LB. BUTTER FAT.											
Wattle Creek Vera	A.I.S.	....	10-10-36	17-12-38	273	25	8,415	4·36	367·49	E. T. Thatcher	Wooroloo Duchess' Guardian (3621)
Koojan Bo-Peep 2nd	Guernsey	7246	2-4-37	15-1-39	273	23	6,609	5·39	355·90	A. W. Padbury	Koojan Ace's Aristocrat (2730)
Brookfields Beauty	do.	6831	30-9-36	16-12-38	273	25	6,743	5·22	351·75	P. G. Hampshire	Koojan Ace's Majestic (2735)
Grantham Dreaming Fairy ...	Jersey	61951	6-4-37	22-6-39	273	12·5	6,053	5·30	321·00	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Greenmount Milk Maid 2nd	do.	....	20-9-37	16-8-39	273	13	6,114	5·23	319·53	A. J. B. Strempel ...	Greenmount Bonetienne's Tornado (11662)
Wooroloo Sunbeam	A.I.S.	23273	24-10-36	29-12-38	273	24	7,437	4·24	315·13	Wooroloo Sanatorium Farm	Wooroloo Triumph 3rd
Crantock Golden Bell ..	Jersey	....	13-8-37	25-9-39	273	8	5,454	5·73	312·56	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Glanavon Lulu	A.I.S.	...	25-10-36	10-2-39	273	29	7,497	4·15	311·09	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Congelin Tangerine 2nd	Jersey	.	30-8-37	22-6-39	273	13	6,144	5·01	308·23	B. P. Hack	Rosecliffe Marchalong (15094)
Brookfields Morden Lady 2nd	Guernsey	6838	19-9-37	9-9-39	273	14	6,012	5·11	306·64	P. G. Hampshire	Koojan Ace's Majestic (2735)
Wooroloo Joy 3rd	A.I.S.	23252	16-8-37	22-8-39	273	21	7,488	4·06	303·86	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Brookfields Honour	Guernsey	6836	8-9-37	9-9-39	273	13	5,139	5·87	301·59	P. G. Hampshire	Koojan Ace's Majestic (2735)
Brookfields Duchess	do.	6835	3-6-37	5-5-39	273	7·5	5,502	5·48	301·22	W. Darnell	Brookfields Majesty (3254)
Crantock Silk Socks	Jersey	.	6-6-37	9-3-39	273	21	6,183	4·84	299·46	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Colmyn Golden Dawn	do.	65987	8-10-37	3-9-39	273	8	5,799	5·07	293·96	C. H. Ironmonger ..	Clarendon Eyre Golden Oxford (13606)
Crantock Starbright Napoleonette 2nd	do.	.	5-7-37	5-4-39	273	20	5,535	5·22	288·90	Mrs. G. H. Burnside ..	Crantock Blonde's Napoleon (8207)
Rutherwood Rosebud	Guernsey	7827	15-7-37	18-8-39	273	14	5,967	4·81	287·07	Claremont Hospital for Insane	Denmark Robin Hood (3322)
Claremont Mabel 10th	A.I.S.	. .	4-4-37	18-8-39	273	20	6,945	4·10	288·36	Misses Rutherford ..	Wooroloo Triumph 4th (3627)
Congelin Iolanthe 2nd	Jersey	. .	7-6-37	9-4-39	273	14·5	4,724	6·07	286·82	B. P. Hack . .	Clarendon Eyre Eminent's Geishar 4th (13597)
Wooroloo Pearl 5th	A.I.S.	23624	1-10-36	17-2-39	273	18	6,234	4·54	282·83	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Denmark Orange Pekoe ..	Guernsey	5444	11-6-36	6-10-39	273	19	6,717	4·61	282·35	Denmark Research Station	Denmark Damon (2519)
Radyr Park Princess 3rd ..	Jersey	.	17-6-37	17-8-39	273	7	4,836	5·83	281·86	L. Temple	Greenmount Graceful Lad (7292)
Congelin Iolanthe 3rd ..	do.		10-6-37	28-3-39	273	21	6,183	4·54	280·83	B. P. Hack	Clarendon Eyre Eminent's Geishar 4th (13597)
Glanavon Doris 5th ...	A.I.S.	....	5-12-36	14-1-39	273	26	6,798	4·09	278·09	D. Bevan & Sons ...	Blacklands Jean's Supreme (1871)
Glanavon Elaine 2nd	do.	. .	14-2-37	19-4-39	273	18	5,907	4·66	275·05	D. Bevan & Sons ...	Blacklands Jean's Supreme (1871)
Crantock Eminent's Sunshinette	Jersey	...	1-1-37	7-3-39	273	20	5,910	4·64	274·52	Mrs. G. H. Burnside ..	Congelin Eminent's Golden (13623)
Glanavon Ettie	A.I.S.	...	25-2-37	10-5-39	273	20	6,630	4·12	273·29	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Koojan Ace's Wavelet 2nd	Guernsey	7245	2-3-37	14-1-39	273	15	4,703	5·81	273·08	A. W. Padbury	Homestead Ace (imp.) (1631)
Denmark Angeline	do.	6956	4-7-37	24-9-39	273	18	5,199	5·22	271·46	Denmark Research Station	Koojan Golden Prosper (2283)

Yanget Gwen 2nd	A.I.S.	....	12–11–36	26–3–39	273	23	8,079	3·36	271·45	A. E. Grant	Leylands Defiance (2380)
Radyr Park Dorothy 7th	Jersey	....	26–6–37	16–7–39	273	10·5	4,682	5·78	270·96	L. Temple	Radyr Park Estrellita's Duplex (15050)
Yanget Flash 2nd	A.I.S.	23300	14–8–36	13–1–39	273	29	7,407	3·66	270·59	A. E. Grant	Sunrise of Parkview (1875) (I.M.S.)
Yanget Champagne's Lovely	do.	23294	2–5–36	6–10–38	273	11	6,318	4·26	268·99	A. E. Grant	Sunrise of Parkview (1875) (I.M.S.)
Coogely Jonquil	Guernsey	6945	1–11–37	26–4–39	273	13	4,532	6·03	268·40	Denmark Research Station	Coogely Judy's Goldmine (2621)
Claremont Mabel 8th	A.I.S.	....	13–9–36	14–2–39	273	26	6,993	3·83	268·29	Claremont Hospital for Insane	Claremont Herdsman (968)
Colmyn Golden Joy	Jersey	65988	3–9–37	4–6–39	273	10·5	5,042	5·31	267·99	C. H. Ironmonger	Clarendon Eyre Golden Oxford (13606)
Wooroloo Rita	A.I.S.	23268	27–2–37	30–5–39	273	16	6,483	4 10	267·42	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Rosy Hill Pearl 10th	Jersey	....	1–6–37	19–8–39	273	16	4,863	5·48	266·61	M. T. Padbury	Glen Iris Star (9492)
Yanget Miss Tottie 2nd	A.I.S.	23307	10–9–36	26–12–38	273	20	6,000	4·42	265·31	A. E. Grant	Sunrise of Parkview (1875) (I.M.S.)
Crantock Golden Cream 3rd	Jersey	....	30–5–37	27–3–39	273	17	5,286	4·92	259·91	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Glanavon Addie 4th	A.I.S.	....	14–5–37	5–8–39	273	17	6,156	4·16	256·42	W. G. Burges	Glanavon Nimrod (437)
Wooroloo Favourite	do.	23242	19–6–37	2–4–39	273	19	6,237	4·11	256·40	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Koojan Ace's Delight	Guernsey	7249	18–11–36	1–1–39	273	17·5	5,018	5·09	254·64	J. R. Giles	Koojan Ace's Aristocrat (2730)
Denmark Du Barry	do.	6964	19–7 37	10–9–39	273	15	5,250	4·85	254·63	Denmark Research Station	Koojan Golden Prosper (2283)
Radyr Park Estrellita 2nd	Jersey	68753	26–8–36	13–10 38	273	12	4,431	5·66	250·91	L. Temple	Radyr Park Lady's Starlight (13128)
Glanavon Dulcie 2nd	A.I.S.	....	18 4 37	28–7 39	273	16	6,048	4·80	250·49	W. G. Burges .	Parkview Commodore (306)
Crantock Napoleon's Lily	Jersey	66067	21 9–36	22–2–39	273	19·5	6,059	4·11	249·91	Mrs. G. H. Burnside ..	Crantock Blonde's Napoleon (8207)
Glanavon Royal Venus ..	A.I.S.	....	5–10–36	26–3–39	273	13	5,520	4·52	249·81	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Brookfields Loyalty	Guernsey	6837	12–5–37	3–3–39	273	16	4,563	5·47	249·76	P. G. Hampshire ..	Koojan Ace's Majestic (2735)
Wooroloo Jeanette 3rd	A.I.S.	....	2–8–37	4–10–39	273	16	5,718	4·35	248·96	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Garden Hill Linda	Jersey	....	23–4–37	23–9–39	273	13	4,224	5·88	248·35	W. Padbury	Clarendon Eyre Golden Oxford (13606)
Colmyn Goldflake	do.	65982	20–8–37	2–8–39	273	9·5	5,804	4·25	246·62	C. H. Ironmonger	Clarendon Eyre Golden Oxford (13606)
Glanavon Melba	A.I.S.	....	21–12–36	9–3–39	273	18	6,864	3·59	246·02	D. Bevan & Sons	Parkview Commodore (306)
Crantock Eminent Cream	Jersey	....	2–3–37	4–5–39	273	11	4,233	5·79	245·11	Mrs. G. H. Burnside	Congelin Eminent's Golden (13623)
Colmyn Butter Queen	do.	65981	14–1 37	25–6–39	273	9·5	4,349	5·63	245·04	C. H. Ironmonger	Colmyn Butter King (12568)
Colmyn Lola	do.	65989	24–6–37	4–6–39	273	8·5	5,081	4·81	244·62	C. H. Ironmonger	Clarendon Eyre Golden Oxford (13606)
Wooroloo Beryl	A.I.S.	23231	12–2–37	16–5–39	273	16	5,433	4·45	241·91	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3611)
Brookfields Blonde	Guernsey	6834	24 8–37	10–9–39	273	8	4,164	5·81	241·85	P. G. Hampshire	Koojan Ace's Majestic (2735)
Glanavon Florrie	A.I.S.	....	24–2–37	11–5–39	273	12	5,496	4·43	241·03	D. Bevan & Sons	Glanavon Nimrod (437)
Westby Dahlia	do.	....	17–9–37	26–8–39	273	13	6,549	3·64	238·58	Burkitt & Brown	Telyarup Duke (956)
Denmark Briar Rose	Guernsey	6959	15–8–37	20–9–39	273	14	4,902	4·78	234·22	Denmark Research Station	Denmark Illustrious (3320)
Glanavon Elsie 2nd	A.I.S.	....	29–1–37	15–1–39	273	20	5,970	3·90	233·13	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Denmark Bonnie Mary	Guernsey	6958	30–9–37	21–9–39	273	15	4,680	4·97	232·49	Denmark Research Station	Denmark Illustrious (3320)
Colmyn Gold Buttercup	Jersey	65986	2–9–37	4–9–39	273	10	5,325	4·35	231·83	C. H. Ironmonger	Clarendon Eyre Golden Oxford (13606)
Grantham Sweet Dreams 2nd	do.	61956	3–2–37	3–2–39	273	20·5	5,042	4·58	230·92	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Glanavon Daphne 3rd	A.I.S.	....	13–2–37	29–4–39	273	17	5,661	4·00	226·82	D. Bevan & Sons	Parkview Commodore (306)
Wooroloo Poppy 3rd	do.	23266	9–5–37	4–4–39	273	13	5,019	4·52	226·28	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for Last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS UNDER 2½ YEARS—*continued.*											
Claremont Rachel 11th	A.I.S.	....	2-5-37	17-8-39	273	16	5,658	3·98	225·20	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Claremont Primrose 5th	do.	....	29-3 37	12 6-39	273	15	5,745	3·91	224·48	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Garden Hill Lucky Ginger 2nd	Jersey	..	3-6-37	18-8-39	273	10	3,427	6·52	223·66	W. Padbury ..	Rosy Hill Perfection (14173)
Tipperary Dove 9th	A.I.S.	....	2-10-37	16-9-39	273	14	4,947	4·45	222·29	W. G. Burges	Blacklands Monarch's Commander (1877)
Wendowie Dainty	Guernsey	8080	5 9-37	2 9-39	273	9	4,467	4·94	220·60	S. F. Russell .	Muresk Golden Chief (2925)
Wattle Creek Pride	A.I.S.	..	15 11 36	9 5 39	240	17	5,850	3·71	217·05	E. T. Thatcher	Yanget Autumn Sun (3630)
Yanget Pretty Maid 2nd	do.	..	28-10-37	7-10-39	273	13·5	4,616	4·69	216·50	W. G. Burges .	Sunrise of Parkview (1875) (I.M.S.)
Claremont Maggie 9th	do.	...	28-11-36	9-1 39	273	16	5,433	3·95	214·29	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Radyr Park Dorothy 8th	Jersey	....	24-8 37	29-6-39	273	9	4,002	5·35	214·16	L. Temple	Radyr Park Estrellita's Duplex (15050)
Wooroloo Rose 5th	A.I.S.	23270	9-11-36	14-10-38	273	8	4,254	5·01	213·29	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Claremont Clara 9th	do.	..	19-7-36	1 11 38	273	18	5,409	3·93	212·46	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
The Wold Starbright Oxford	Jersey	....	31-5 37	6 7-37	210	11	3,915	5·17	202·62	L. C. Field .. .	Clarendon Eyre Oxford Pioneer (11484)
Denmark Morning Glory	Guernsey	6967	21 6-37	24-9-39	273	10·5	4,067	4·88	198·40	Denmark Research Station	Denmark Damon (2519)
Coogely Heiress	do.	6944	15 5-37	7 10 39	240	11	4,140	4·70	194·28	P. G. Hampshire	Coogely Judy's Goldmine (2621)
The Wold Fairy Grey .	Jersey	.	1-7-37	28-7 39	210	4·5	3,555	5·43	193·11	L. C. Field ..	Gratham Fairy King (13765)
Brookfields Queen 5th ..	Guernsey	6842	15 4 38	20 9-39	273	8	3,534	5·14	181·74	W. Darnell .	Brookfields Baron (3936)
Travalgan Lady Elon 3rd	Jersey	.	15 3 38	24-4 39	273	9	2,892	6·24	180·45	Robinson Bros. . .	Glen Iris Golden Oxford (12694)
Wooroloo Trixie	A.I.S.	23276	4-11-36	11 2-39	180	15	3,795	4·34	165·00	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Capel Shirley's Beauty	do.	19487	18 3-37	3 9-39	150	19·5	4,275	3·85	164·61	B. W. Prowse ..	Broka Victory (1910)
Colmyn Gold Lady	Jersey	65984	14-8 37	2-8 39	273	7	3,591	4·51	163·80	C. H. Ironmonger ..	Clarendon Eyre Golden Oxford (13606)
Summerlea Joan 4th	A.I.S.	....	28 8 37	30 9 39	210	12	4,110	3·75	154·11	Dunkley Bros.	Leyland's Reward (3331)
Tipperary Fairy 4th ..	do.	.	27 11-37	14-9-39	240	5·5	3,225	4·56	147·12	W. G. Burges ...	Blacklands Monarch's Commander (1877)
Wooroloo Opal	do.	23261	8-3 37	23-3-39	210	13·5	3,285	4·57	147·03	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Congelin Noble Lass	Jersey	.	1 5 37	17 5-39	90	24	2,295	5·42	124·71	B. P. Hack	Clarendon Eyre Eminent's Geishar 4th (13597)
Glanavon Golden Girl 2nd	A.I.S.	..	22 4-37	7 6-39	90	20	2,160	3·53	76·26	D. Bevan & Sons	Parkview Commodore (306)
Claremont Cherry 14th	do.	...	23 10-37	28-1-40	90	21	1,890	3·66	69·30	Claremont Hospital for Insane	Claremont Max Hero (3802)
Brackenhurst Rose 2nd ..	do.	.	2 11-37	21-10-39	60	24	1,560	4·35	67·98	B. W. Prowse ..	Thornleigh Champagne (930)
Claremont Stella 9th	do.	.	17-7 37	19 10 39	60	26·5	1,665	3·89	64·77	Claremont Hospital for Insane	Claremont Herdsman (968)

COWS 2½ YEARS AND UNDER 3 YEARS—STANDARD 250 LBS. BUTTER FAT.

Denmark Rosemary	Guernsey	5451	7–6–36	4 6 39	273	9	7,146	5·65	403·55	Denmark Research Station	Koojan Golden Prosper (2283)
Koojan Ace's Dulcie	do.	5658	6–3–36	25 10 38	273	22·5	6,466	5·74	370·89	A. W. Padbury	Homestead Ace (imp.) (1631)
Grass Vale Buttercup	Jersey	66780	11–9 36	9 9 39	273	19	5,922	5·79	343·23	R. H. Rose	Selsey Gay Boy (15134)
Radyr Park Dorothy 5th	do.	68752	18 7 36	14–7–39	273	11·5	6,050	5·66	339·21	L. Temple	Greenmount Graceful Lad (7292)
Yanget Della 3rd	A.I.S.	23296	1–4–36	17 12 38	273	29	8,667	3·91	338·91	A. E. Grant	Leyland's Defiance (2380)
Crantock Napoleon's Primula 3rd	Jersey	66068	21 6 36	1 5–39	273	11·5	6.050	5·53	334·61	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Wattle Creek Star	A.I.S.		3–3 37	15 9 39	273	22	7,296	4·55	332·27	E. T. Thatcher	Yanget Autumn Sun (3630)
Grass Vale Nora Lady	Jersey	66788	1–12 36	11 6–39	273	10·5	5,216	6·20	323·43	R. H. Rose	Selsey Gay Boy (15134)
Wooroloo Doreen	A.I.S.	23238	7 2–37	20 8 39	273	17	7,506	4·31	323·40	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)
Namder Daphne	do.	68205	27–10 36	24 9 39	273	12	5,436	5·84	317·31	H. S. Redman	Ventonia Elvira's Masterpiece (13325)
Brookfields Golden Queen 3rd	Guernsey	5324	16 3–36	3 3 39	273	20	6,120	5·15	315·18	P. G. Hampshire	Koojan Ace's Majestic (2735)
Wooroloo Freda 2nd	A.I.S.	23245	9–10–35	21 5 39	240	13	7,380	4·26	314·37	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Grass Vale Golden Cream 15th	Jersey	66783	3–9 36	5–7–39	240	13	5,342	5·82	310·91	R. H. Rose	Selsey Gay Boy (15134)
Denmark Rosette	Guernsey	6972	21 7–36	4–6 39	273	10	6,030	5·14	310·15	Denmark Research Station	Koojan Golden Prosper (2283)
The Wold Starbright's Princess	Jersey	64562	4–6 36	15 4–39	273	11·5	5,420	5·63	305·28	L. C. Field	Grantham Air Prince 2nd (10657)
Grass Vale Lady Fowler 24th	do.	66786	4–12–36	9–9–39	273	17·5	5,641	5·37	302·89	R. H. Rose	Selsey Gay Boy (15134)
Glanavon Gem 2nd	A.I.S.		19 10–36	14–4 39	273	24	7,422	4·08	302·64	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Crantock Golden Cream 2nd	Jersey		1 5–36	30–4–39	273	11	6,093	4·95	301·94	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Westby Carnation 3rd	A.I.S.	23137	25 8 36	13 3–39	273	26	7,608	3·84	292·39	R. J. Morgan	Telyarup Duke 956
Capel Daphne	do.		20–6 36	18–5–39	273	19·5	7,889	3·64	287·14	B. W. Prowse	Wooroloo Premier 6th (2973)
Grantham Sweet Dreams	Jersey	61955	15 1 36	11–6 39	273	15	5,445	5·17	281·53	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Radyr Park Estrellita 2nd	do.	68753	26 8–36	19–8–39	273	6·5	4,633	5·93	274·65	L. Temple	Radyr Park Lady's Starlight (13128)
Yanget Snowdrop	A.I.S.	23313	31–5–36	27–12–38	273	22	6,456	4·25	274·39	A. E. Grant	Sunrise of Parkview (1875)
Wooroloo Doris	do.	23239	4 2–37	11 8 39	273	10	5,805	4·67	270·87	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Capel Noraleda Pretty	Jersey	65870	17 8 36	25–7–39	210	17	5,865	4·62	270·63	B. W. Prowse	Sabina Vale Silver Chief (13223)
Capel Model 2nd	A.I.S.		20 6 36	27–4 39	273	17	6,981	3·86	269·82	B. W. Prowse	Wooroloo Premier 6th (2973)
Westby Lupin 7th	do.	23140	1–10–36	28–5 39	273	6	6,588	4·09	269·60	R. J. Morgan	Telyarup Duke (956)
The Wold Princess Daisy	Jersey	64561	7–8–36	21–7 39	180	14	4,575	5·85	267·48	L. C. Field	Grantham Air Prince 2nd (10657)
Wooroloo Princess	A.I.S.	23267	7 2–37	20 8 39	273	14	6,192	4·28	265 48	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)
Wooroloo Dessie	do.	23236	25 2–37	29 8 39	273	13	6.009	4·36	261·94	Wooroloo Sanatorium Farm	Wooroloo Duke 6th (3622)
Yanget Milkmaid 5th	do.	23305	19 3 36	4–10–38	273	10	6,960	3·66	256·22	A. E. Grant	Sunrise of Parkview (1875)
Colmyn Topsy	Jersey	65991	1–10 36	27–8–39	273	9·5	6,224	4·11	255·59	C. H. Ironmonger	Colmyn Prince Victor (10492)
Capel Cream Sox 2nd	do.	65863	8–10 36	30–6–39	273	12	5,676	4·49	254·99	B. W. Prowse	Sabina Vale Silver Chief (13223)
Claremont Blossom 21st	A.I.S.		22–9–36	26–3 39	273	20	7,159	3·42	245·69	Claremont Hospital for Insane	Claremont Lyle Earl (3093)
Claremont Poppy 9th	do.		2 5 36	8–3 39	273	20	6.488	3·73	241·67	Claremont Hospital for Insane	Claremont Herdsman (968)
Wattle Creek Roany	do.		25 11 36	14–6–39	273	16	6,378	3·77	241·02	E. T. Thatcher	Wooroloo Duchess' Guardian (3621)
Glanavon Pansy 3rd	do.		26–11 36	13–6–39	273	17	6,051	3·98	240·76	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Wattle Creek Rosie	do.		1–3–37	15–9–39	273	16	5,898	3·95	232·78	E. T. Thatcher	Yanget Autumn Sun (3630)
Wooroloo Rose 5th	do.	23270	9–11–36	9–10–39	210	11	4,935	4·65	231·45	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Claremont Flora 3rd	do.		5 8 36	10 4–39	273	15	5,865	3·86	226·74	Claremont Hospital for Insane	Wooroloo Persimmon (2972)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for Last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
COWS 2½ YEARS AND UNDER 3 YEARS—*continued.*						lb.	lb.	%	lb.		
Juadine Sparkle 15th	Jersey	67234	23-12-36	7 9 39	273	6	4,543	4·89	222·07	Miss L. G. Hancock .	Juadine Paragon (12827)
Summerlea Milkmaid 26th	A.I.S.	....	4 9-36	16-5 39	273	11	5,973	3·60	216·24	Dunkley Bros. ...	Greyleigh Asteroid (2184)
Claremont Maggie Morrison 20th	do.	..	12 7-36	15 4-39	273	17	5,331	4·05	215·82	Claremont Hospital for Insane	Claremont Herdsman (938)
Congelin Velveteen	Jersey	66011	4-12 36	7-9-39	180	12·5	3,960	5·36	212·16	B. P. Hack	Rosecliffe Sybil's Mariposa (9997)
Claremont Cocky 12th .	A.I.S.	.	19-1 37	7 9-39	273	17	5,181	4·08	211·40	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Claremont Flora 6th	do.	....	5-12-36	20-7-39	273	15	5,385	3·91	210·66	Claremont Hospital for Insane	Claremont Herdsman (968)
Travalgan Lady Eion 2nd	Jersey	59777	29 9 36	25 5-39	273	6·5	3,470	6·01	208·79	Robinson Bros. ..	Travalgan Northern Noble (10124)
Summerlea Red Rose 9th .	A.I.S.	....	19-5-36	4-5 39	240	15	5,265	3·80	201·29	Dunkley Bros. .	Greyleigh Asteroid (2184)
Summerlea Princess 5th .	do.		26-5-36	4-5 39	240	2·5	5,550	3·40	189·24	Dunkley Bros.	Greyleigh Asteroid (2184)
Summerlea Jean	do.	..	22-8-36	1 5-39	210	20·5	5,280	3·50	189·16	Dunkley Bros. .	Greyleigh Asteroid (2184)
Westby Polly 4th	do.	23145	30 3 36	11 11-38	210	18	4,590	3·80	176·58	Bayley Bros. ...	Telyarup Duke (956)
Claremont Whitby Maid 26th	do.	..	8 8 36	3-4-39	90	21	2,190	3·96	86·79	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Grantham Oxford Pride	Jersey	66777	9-6-37	12 2-40	60	21	1,440	4·07	58·44	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Congelin Firefly 2nd	do.	66010	3-10-36	28-7-39	30	23	690	4·83	33·33	B. P. Hack	Clarendon Eyre Eminent's Geishar 4th (13597)
COWS 3 YEARS AND UNDER 3½ YEARS—STANDARD 270 LB. BUTTER FAT.											
Travalgan Starbright 3rd ..	Jersey	59778	1-5 36	6 7 39	273	25	8,340	5·65	471·04	Robinson Brothers .	Travalgan Northern Noble (10124)
Greenmount Golden Lass .	do.	. .	30 9 36	9 10 39	273	14·5	5,614	6·41	424·11	A. J. B. Strempel .	Bellefaire Bonaparte's Bonnetienne (9224)
Congelin Rose Marie	do.	61154	5-4 35	12-4 38	273	20·5	6,362	5·61	412·25	B. P. Hack	Rochette's Golden (imp.) (7962)
Wooroloo Moss Rose 4th ..	A.I.S.	23259	22 4 35	8 10 38	273	23	8,139	4·61	375·54	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Wooroloo Empress	do.	23241	1-11-35	23-3-39	273	21	8,681	4·13	358·16	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Greenmount Flash Maid .	Jersey	61972	28 1-36	18 3 39	273	20	6,600	5·35	353·29	A. J. B. Strempel	Greenmount Golden Flash (12736)
Wooroloo Joy 2nd	A.I.S.	23251	3-8 35	10 1 39	273	24	8,272	4·06	336·19	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Crantock Napoleon's Daisy .	Jersey	61210	26-7 35	16 12 38	273	23	6,626	4·81	318·47	Mrs. G. H. Burnside . .	Crantock Blonde's Napoleon (8207)
Denmark Annette	Guernsey	5435	17 7 35	4 10 38	273	15	5,228	5·96	311·73	Muresk Agricultural College	Koojan Golden Prosper (2283)
Grantham Air Lady 3rd .	Jersey	61950	28 4 36	20 6 39	273	11·5	5,375	5·77	310·07	J. A. Sears . . .	Greenmount Black Prince (6511)
Rutherwood Rosalyn ...	Guernsey	6264	18-8 35	11-1 39	273	16	5,208	5·85	304·13	Misses Rutherford ..	Denmark Rosa's Prosper (2639)
Denmark Wild Rose	do.	6974	1 7 36	29-7 39	273	9	6,027	5·05	304·02	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Rose 4th	A.I.S.	23269	2-1 36	29-5-39	273	18	7,074	4·26	301·57	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
The Wold Northwood Crescendo	Jersey	64559	16-4-36	27 4 39	273	9	4,602	6·40	294·43	L. C. Field	Grantham Air Prince 2nd (10657)
Wooroloo Dove 3rd	A.I.S.	23240	4-8 35	26 11 38	210	30	6,900	4·26	293·94	Wooroloo Sanatorium Farm	Parkview Guardian (2557)

Brookfields Lady Charity	Guernsey	....	27- 1-36	28 1 39	273	18	4,734	6·19	292·92	P. G. Hampshire	Koojan Ace's Majestic (2735)
Radyr Park Clarionette	Jersey	68751	9–2 36	26–7–39	273	8	4,831	6·06	292·77	L. Temple	Graceful Lad of Greenmount (7292
Denmark Velda	Guernsey	6973	13–7 36	24 7 39	273	8	6,234	4·69	292·52	Denmark Research Station	Denmark Damon (2519)
Brookfields Golden Queen 2nd	do.	5323	10–2 36	2–3–39	273	19	4,992	5·79	289·42	P. G. Hampshire	Koojan Ace's Majestic (2735)
Summerlea Joan 2nd	A.I.S.		2–3–36	7 8 39	273	6	8,523	3·37	287·39	Dunkley Bros.	Greyleigh Asteroid (2184)
Gatwick Begum	Jersey		30–3–36	4–9–39	273	13·5	5,246	5·41	283·89	A. J. B. Strempel	Yulelands Stylish Lad (12382)
Denmark Diana	Guernsey	6963	28–6 36	6–7 39	273	8	5,514	5·07	279·78	Denmark Research Station	Denmark Damon (2519)
Denmark Prosperette	do.	5446	17 5 36	9 6–39	273	5	5,655	4·83	273·46	Denmark Research Station	Denmark Damon (2519)
Wendowie Quaker	do.	6476	11 9 35	18 2 39	210	17	4,980	5·40	269·01	S. F. Russell	Muresk Golden Chief (2925)
Yanget Champagne's Lovely	A.I.S.	23294	2 5–36	3–9–39	240	15	6,480	3·89	251·87	A. E. Grant	Sunrise of Parkview (1875) (I.M.S.)
Glanavon Doris 3rd	do.		14 11 35	4 12 38	273	17	6,051	4 03	243·60	D. Bevan & Sons	Parkview Commodore (306)
Claremont Laura 7th	do.		8 2 36	26 3 39	273	21	6,258	3·81	238·18	Claremont Hospital for Insane	Claremont Kandor (1964)
Yanget Rudyard Fussy	do.	23312	20 9–35	4 10 38	273	13	6,549	3·63	238·02	A. E. Grant	Blacklands Lancer (1874)
Claremont Whitby Maid 24th	do.	19618	24 12–35	19–5 39	273	16·5	6,013	3·89	233·37	Claremont Hospital for Insane	Wooroloo Persimmon (2972)
Rutherwood Dame	Guernsey	7825	9 7 36	25–8–39	273	8	4,725	4·91	229·83	Misses Rutherford	Denmark Damon (2519)
Grantham Oxford's Carnation 2nd	Jersey	61953	20 3–36	23 4 39	273	11·5	5,103	4·46	227·33	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Colmyn Bessie	do.	61136	20 5 36	7–10 39	240	11·5	5,160	4·35	224·70	C. H. Ironmonger	Colmyn Prince Victor (10492)
Wallatin Empress	A.I.S.		5–6 36	20 7 39	273	8	4,768	4·38	208·79	Prowse Bros.	Lemon Grove Myrtle's Heir (1453)
Brackenhurst Dairymaid	do.	19306	8 11 35	28–4–39	210	19·5	5,475	3·30	180·84	B. W. Prowse	Thornleigh Champagne (930)
Summerlea Joan 3rd	do.		1 6 36	19–8–39	210	8	5,070	3·52	178·29	Dunkley Bros.	Greyleigh Asteroid (2184)
Cloverdowns Madame	do.	19640	20–9–36	22–10 39	210	17	3,915	4·25	166·47	W. G. Burges	Tipperary Melba's Boy (2869)
Yanget Treasure 2nd	do.	23314	29 4 36	16 8 39	180	14	3,870	4·07	157·86	A. E. Grant	Sunrise of Parkview (1875) (I.M.S.)
Grantham Sweet Dreams 2nd	do.	61956	3–2 37	14 2 40	60	17	1,140	4·36	49·53	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Claremont Biddy 32nd	do.		1 3 36	15 8 39	30	39·5	1,185	3·82	45·24	Claremont Hospital for Insane	Claremont Kandor (1964)

COWS 3½ YEARS AND UNDER 4 YEARS—STANDARD 290 LB. BUTTER FAT.

Crantock Cream Duchess 2nd	Jersey	61209	2–8–35	6 8 39	273	25	8,835	6·25	554·31	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Radyr Park Dorothy 4th	do.	63850	5 10 35	4–7–39	273	14	8,135	5·41	440·23	L. Temple	Greenmount Graceful Lad (7292)
Tipperary Maggie 4th	A.I.S.	18330	15 9 35	17–7–39	273	27	10,206	4·22	430·90	W. G. Burges	Blacklands Monarch's Commander (1877)
Wooroloo Flash 3rd	do.	23243	1–6 36	18–9–39	273	18	9,249	4·20	388·86	Wooroloo Sanatorium Farm	Parkview Guardian (2557) (A.R.)
Greenmount Golden Marinita	Jersey	61974	29–4 35	30–10–38	273	26·5	7,303	5·16	376·52	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Crantock Golden Duchess	do.		8–8 35	25–7–39	273	14·5	7,154	5 07	362·96	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Juadine Peerless Lily 9th	do.	62336	27–9 35	25–9–39	273	8·5	6,041	5·92	355·69	Miss L. G. Hancock	Juadine Sunshine (8212)
Devonia Silver Queen	do.	66223	18–11 35	18 8–39	273	16	6,363	5·57	354·37	W. Padbury	Sabina Vale Silver Chief (13223)
Denmark Bonnie	Guernsey	5437	22–7 35	21–4 39	273	14	7,302	4·57	333·68	Denmark Research Station	Denmark Damon (2519)
Grass Vale Lady Fowler 21st	Jersey	66784	3–11–35	9–8–39	273	11	6,101	5·39	328·59	R. H. Rose	Melrose Lost Key (7974)
Denmark Rose Ophelia	Guernsey	5448	11–7–35	1–7–39	273	12	7,056	4·65	328·48	Denmark Research Station	Koojan Golden Prosper (2283)
Grass Vale Buttercup 2nd	Jersey	66779	22–8–35	9–8 39	273	8·5	5,321	6·09	324·47	R. H. Rose	Spring Park Starbright's Sweet Duke (8221)
Colmyn Janis 2nd	do.	61139	12 9 35	6–7–39	273	10	6,203	5·14	318·71	C. H. Ironmonger	Colmyn Captain Mac (5855)
Claremont Lily 7th	A.I.S.	19599	17–12–35	16–9–39	273	25	8,385	3·71	310·80	Claremont Hospital for Insane	Wooroloo Persimmon (2972)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for Last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
COWS 3½ YEARS AND UNDER 4 YEARS—*continued.*											
						lb.	lb.	%	lb.		
Namder Pride	A.I.S.	63313	25 10–35	20–9–39	273	11	5,268	5·85	308·03	H. S. Redman	Grass Vale Choice Star (12732)
Grantham Princess Starbright 3rd	Jersey	57557	20 9–35	17–7–39	273	10	5,610	5·42	304·15	J. A. Sears	Clarendon Eyre Oxford Pioneer (11484)
Westby Pearl 3rd	A.I.S.	23143	9–1 36	31–7 39	273	9	8,127	3·74	304·15	Burkitt & Brown	Telyarup Duke (956) (A.R.)
Wallatin Pansy	do.	23058	25–10–35	1–6–39	273	7·5	6,912	4·29	296·45	Prowse Bros.	Lemon Grove Myrtle's Heir (1453)
Glanavon Eva	do.	..	20–11–35	29–6–39	273	11	7,233	4·00	289·64	D. Bevan & Sons	Villiers of Darbalara (2386)
Grantham Starbright's Queen 3rd	Jersey	57559	9–8–35	17–7–39	273	13	5,314	5·40	286·96	J. A. Sears	Greenmount Black Prince (6511)
Capel Noraleda 2nd	do.	60992	3–8–35	23–6 39	240	14·5	5,160	5·55	286·53	B. W. Prowse	Capel Carnation's Pride (7988)
Claremont Cherry 11th	A.I.S.	19595	30 10 35	26 5–39	273	21	7,188	3·92	281·58	Claremont Hospital for Insane	Claremont Herdsman (968)
Wooroloo Lady Betty 2nd	do.	23254	8 9–35	27 5 39	273	16	6,318	4·44	280·74	Wooroloo Sanatorium Farm	Triumph of Pine Creek (2515)
Glanavon Dell 2nd	do.	....	26 10 35	2–5 39	273	21	7,668	3·61	276·87	D. Bevan & Sons	Parkview Commodore (306)
Westby Carnation 2nd	do.	18515	12–8 35	30 6–39	273	8	7,118	3·86	274·90	Burkitt & Brown	Telyarup Duke (956)
Glanavon Gem	do.	....	18–11 35	18 7–39	240	8	6,330	4·27	270·12	D. Bevan & Sons	Glanavon Nimrod (437)
Summerlea Hobby 13th	do.	....	2 5–35	3–5–39	273	14·5	7,513	3·50	263·08	Dunkley Bros.	Summerlea Togo (1527)
Colmyn Peggy	Jersey	61141	26 10–35	30–7 39	273	7	5,691	4·14	235·90	C. H. Ironmonger	Colmyn Captain Mac (5855)
Grantham Easter Rye 4th	do.	57554	18–10 35	8 8–39	210	12·5	3,983	5·90	235·74	J. A. Sears	Greenmount Black Prince (6511)
Wallatin Fairy	A.I.S.	23056	21 9–35	16–6 39	273	15	5,700	4·05	231·13	Prowse Bros.	Lemon Grove Myrtle's Heir (1453)
Yanget Lady Thelma	do.	22302	17–3–35	4–10–38	273	16	6,228	3·67	228·89	A. E. Grant	Tipperary Topsy's Monarch (2875)
Summerlea Swallow 8th	do.	....	27–10 35	15 7–39	210	12	6,060	3·62	219·27	Dunkley Bros.	Summerlea Togo (1527)
Crantock Napoleon's Primula 2nd	Jersey	61211	7 7–35	16 3–39	210	14·5	3,743	5·76	215·46	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Capel Princess	A.I.S.	19486	22 9 35	13 5–39	210	11	5,370	4·00	214·14	B. W. Prowse	Wooroloo Premier VI. (2973)
Summerlea Milkmaid 21st	do.	..	24–10–35	9–8 39	273	9	5,682	3·77	213·95	Dunkley Bros.	Summerlea Togo (1527)
Summerlea Milkmaid 20th	do.	....	11–10 35	6 8–39	210	10·5	4,995	3·66	183·03	Dunkley Bros.	Summerlea Togo (1527)
Capel Model	do.	19485	2 8–35	29–5 39	180	15	4,425	3·85	170·31	B. W. Prowse	Thornleigh Champagne (930)
Tipperary Lofty 3rd	do.	22909	2–11 35	29 5–39	90	40	4,020	3·99	159·96	W. G. Burges	Blacklands Monarch's Commander (1877)
Congelin Firefly	Jersey	66009	5–9–35	27–4–39	120	24·5	2,940	5·34	156·93	B. P. Hack	Clarendon Eyre Oxford Dreamer (imp. in dam) (10273)
Moorlands Janie	do.	....	16–11–35	14 8–39	90	20	2,205	6·53	144·00	Estate late P. Rose	Melrose Liberty (7973)
COWS 4 YEARS AND UNDER 4½ YEARS— STANDARD 310 LB. BUTTER FAT.											
Koojan Ace's Jewel 2nd	Guernsey	5661	4 3–35	20 8–39	273	42	13,169	5·19	683·45	A. W. Padbury	Homestead Ace (1631)
Denmark Dawn 2nd	do.	5439	21 3 35	26 7 39	273	17	8,571	6·01	514·70	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Bonnie	A.I.S.	18626	29–10 34	24 3 39	273	31	11,373	4·25	483·24	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Greenmount Golden Wonder	Jersey	61975	28 3–35	21 8–39	273	18	8,581	5·36	460·99	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Greenmount Gentle Lady	do.	61973	8–8–35	3–10 39	273	17	7,371	6·14	452·98	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Tipperary Dove 2nd	A.I.S.	18321	9–7–34	21–10–38	273	27·5	11,686	3·71	433·12	B. W. Prowse	Parkview Rosie's Monarch (1681)
Norric Peggy	do.	....	14–4–35	8–7–39	273	15	10,575	4·07	429·94	W. G. Burges	Warwick Rufus (3595)
Yanget Victress	do.	18662	29–7–35	16–9–39	273	23	9,969	4·20	419·49	A. E. Grant	Sunrise of Parkview (1875)

Wooroloo Dell	do.	18628	18-10-34	23-3-39	273	28	10,419	4·01	418·10	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Tipperary Sally	do.	18338	23-4-35	31-5-39	273	23	10,929	3·82	417·02	W. G. Burges	Blacklands Monarch's Commander (1877)
Glanavon Fairy	do.	20204	22-12-34	24-6-39	273	27	10,131	4·09	415·19	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Glanavon Tiny	do.	20212	25-9-34	19-3-39	273	24	9,462	4·32	408·37	D. Bevan & Sons	Blacklands Jean's Supreme (1871)
Coogely Zonia	Guernsey	5430	4-7-34	18-10-38	273	25·5	7,862	5·18	407·08	A. W. Padbury	Koojan Fortywinks (2738)
Yanget Melba	A.I.S.	23304	12-5-35	19-9-39	273	22	9,216	4·34	400·58	Wooroloo Sanatorium Farm	Parkview Sunrise (1875)
Congelin Rose Marie 2nd ...	Jersey	61155	2-5-36	2-6-39	273	12	6,276	5·76	390·44	B. P. Hack	Clarendon Eyre Oxford Gamboge (10274)
Colmyn Brown Maggie	do.	56859	27-6-35	4-8-39	273	12·5	7,133	5·25	374·22	C. H. Ironmonger	Colmyn Prince Victor (10492)
Brookfields Mignonette	Guernsey	5329	18-6-35	2-7-39	273	10	7,237	5·02	363·70	W. Darnell	Koojan Lord Barklay (1031)
Congelin Iolanthe	Jersey	61152	27-3-35	13-4-39	273	19·5	8,264	4·35	360·14	B. P. Hack	Rochette's Golden (imp.) (7962)
Wooroloo Fairy 2nd .	A.I.S.	18631	3-12-34	3-5-39	273	17	9,811	3·63	356·37	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Brookfields Bonnie Blossom	Guernsey	5319	15-8-34	15-10-38	273	18·5	6,926	5·10	353·37	W. Darnell ...	Koojan Lord Barklay (1031)
Westby Carnation	A.I.S.	18514	30-5-35	28-8-39	273	14	9,349	3·76	351·37	Burkitt & Brown	Telyarup Duke (956)
Denmark Irish Rosette	Guernsey	5442	27-3-35	5-7-39	273	12·5	7,238	4·84	350·12	Misses Rutherford	Denmark Damon (2519)
Denmark Atalie	do.	5436	23-6-34	6-12-38	273	22	6,336	5·48	347·39	Misses Rutherford	Koojan Golden Prosper (2283)
Tipperary Dove 4th	A.I.S.	18323	18-7-35	9-8-39	273	20	7,770	4·31	334·96	W. G. Burges	Blacklands Monarch's Commander (1877)
Rosy Hill Pansy	Jersey	59328	6-2-35	9-7-39	273	14	5,322	6·01	320·13	M. T. Padbury	Spring Park Starbright's Sweet Duke (8221)
Crantock White Stockings	do.	56955	9-4-35	21-9-39	273	7·5	8,671	3·68	319·54	Mrs. G. H. Burnside	Crantock Blonde's Napoleon (8207)
Congelin Tangerine	do.	61156	13-6-35	15-7-39	273	11	6,237	5·11	318·95	B. P. Hack	Clarendon Eyre Oxford Gamboge (10274)
Greenmount Golden Dewdrop	do.	57569	7-8-34	20-1-39	210	24	5,250	5·83	305·88	A. J. B. Strempel	Bellefaire Bonaparte's Bonetienne (9224)
Brookfields Primrose	Guernsey	5331	24-2-35	20-6-39	240	9	5,910	5·02	296·73	W. Darnell ..	Koojan Ace's Majestic (2735)
Rosy Hill Venus	Jersey	64111	27-8-35	19-9-39	273	8	5,124	5·78	295·91	M. T. Padbury	Rosy Hill Pearl's Chief (12136)
Leylands Champagne's Lovely	A.I.S.	12249	5-6-34	7-11-38	273	17	7,611	3·87	294·66	A. E. Grant	Thornleigh Champagne (930)
Yanget Della 2nd	do.	15409	3-5-34	13-10-38	273	12	7,581	3·88	294·11	A. E. Grant	Sunrise of Parkview (1875)
Yanget Florrie	do.	18653	18-3-35	1-9-39	210	22·5	7,560	3·82	289·09	A. E. Grant	Sunrise of Parkview (1875)
Wendowie Empress	Guernsey	8082	17-2-35	12-3-39	210	17	5,250	5·06	265·44	S. F. Russell ...	Koojan Lord Barklay (1031)
Norric Daisy Bell	A.I.S.	...	23-4-35	2-9-39	210	16	6,510	4·05	263·58	W. G. Burges	Warwick Rufus (3595)
Radyr Park Melody	Jersey	59126	26-1-35	2-3-39	273	13·5	4,376	5·83	255·12	L. Temple	Graceful Lad of Greenmount (7292)
The Wold Air Daisy	do.	59710	26-4-35	24-7-39	210	5	4,995	4·66	232·86	L. C. Field	Grantham Air Prince 2nd (10657)
Moorlands Janet	do.	...	25-3-35	17-7-39	120	25·5	3,945	4·71	185·85	Estate late P. Rose	Preston Prospector (11024)
Summerlea Dairymaid 21st	A.I.S.		2-8-35	25-8-39	210	14	5,055	3·50	177·15	Dunkley Bros.	Summerlea Togo (1527)
Moorlands Jolly	Jersey	....	28-3-35	3-7-39	120	27·5	3,750	4·69	176·10	Estate late P. Rose	Preston Prospector (11024)
Grass Vale Lady Fowler 20th	do.	61959	29-5-35	17-8-39	60	32	2,910	5·27	115·35	R. H. Rose	Spring Park Starbright's Sweet Duke (8221)

COWS 4½ YEARS AND UNDER 5 YEARS—STANDARD 330 LB. BUTTER FAT.

Travalgan Starbright 2nd	Jersey	55608	4-9-34	30-5-39	273	25	8,445	5·45	460·87	Robinson Bros.	Travalgan Northern Noble (10124)
Glanavon Vera	A.I.S.	16494	14-1-34	7-1-39	273	28	6,804	5·90	401·22	E. T. Thatcher	Glanavon Nimrod (437)
Juadine Sparkle 11th ..	Jersey	57870	14-8-34	26-4-39	273	21	8,223	4·27	351·05	B. P. Hack	Juadine Sunshine (8212)
Crantock Cream Duchess	do.	56952	15-9-34	14-6-39	273	18·5	6,836	5·10	349·09	Mrs. G. H. Burnside ...	Crantock Blonde's Napoleon (8207)
Brookfields Glory	Guernsey	4059	15-3-34	24-1-39	273	24	6,492	5·23	340·02	P. G. Hampshire	Koojan Ace's Chancellor (2274)
Brookfields Lady Lynette .	do.	5327	21-7-34	12-6-39	273	10	6,945	4·78	332·59	W. Darnell .. .	Koojan Lord Barklay (1031)
Colmyn Violet	Jersey	52322	6-10-34	8-8-39	273	9	6,537	5·01	327·82	C. H. Ironmonger	Colmyn Prince Victor (10492)
Glanavon Sunbeam 6th	A.I.S.	20211	8-11-34	28-7-39	273	16	6,788	4·80	325·82	D. Bevan & Sons	Glanavon Nimrod (437)
Brookfields Lady Hope	Guernsey	5325	14-9-34	11-6-39	273	11	6,438	5·00	322·47	W. Darnell	Koojan Lord Barklay (1031)
Rutherwood Rosette	do.	6265	23-8-34	19-7-39	273	11·5	6,005	5·34	320·25	Misses Rutherford ...	Denmark Rosa's Prosper (2639)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for Last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS 4½ YEARS AND UNDER 5 YEARS—*continued.*											
The Wold Merry Daisy	Jersey	55528	14–8–34	13–5–39	273	11	5,388	5·85	314·94	L. C. Field	Merry King of Greenmount (4306)
Moorlands Italy	do.	68074	20–7–34	15–3–39	240	19·5	5,745	5·33	306·24	Estate late P. Rose	Melrose Liberty (7973)
Capel Gladys Queen ..	do.	60990	21–9–34	27–6–39	240	15	5,715	5·16	295·16	B. W. Prowse	Capel Carnation's Pride (7988)
Grass Vale Molly's Nora ..	do.	57561	9–8–34	30–6–39	240	15·5	5,439	5·37	292·14	R. H. Rose	Banyule Silvermine's Twylish (7600)
Moorlands Iliad	do.	....	12–6–34	21–3–39	210	16	4,598	5·70	262·00	Estate late P. Rose	Melrose Liberty (7973)
Capel Pretty	do.	56710	16–8–34	22–5–39	210	17	4,905	4·41	215·19	B. W. Prowse	Devonia Makarina (8217)
Summerlea Sheila 3rd	A.I.S.	22529	21–3–35	19–10–39	210	7·5	5,940	3·60	213·96	Dunkley Bros.	Summerlea Togo (1527)
COWS 5 YEARS AND OVER—STANDARD 350 LB. BUTTER FAT.											
Blacklands Ettie 9th	A.I.S.	9298	24–9–32	18–9–39	273	51	17,523	4·43	776·91	D. Bevan & Sons	Parkview Limelight (370)
Koojan Lady Olive	Guernsey	4340	11–2–33	12–9–39	273	34·5	11,369	5·39	612·28	A. W. Padbury	Homestead Ace (imp.) (1631)
Beauna Vista Fairy 5th	A.I.S.	1322	8–12–29	19–5–39	273	41	16,653	3·67	610·21	Prowse Bros.	Spearfelt of Alne Bank (1029)
Koojan Ace's Jewel ...	Guernsey	4333	19–2–33	22–4–39	273	34	11,067	5·42	600·05	A. W. Padbury	Homestead Ace (imp.) (1631)
Koojan Golden Butterfly	do.	4339	18–4–33	1–5–39	273	32·5	10,223	5·49	561·57	A. W. Padbury	Koojan Ace (2270)
Koojan Ace's Pixie	do.	4336	11–4–33	15–9–39	273	33	10,825	5·14	555·88	A. W. Padbury	Homestead Ace (imp.) (1631)
Travalgan Lady Mint 4th	Jersey	55607	11–4–34	8–5–39	273	22	9,156	5·83	533·81	Robinson Bros. ..	Banyule Altitude (5793)
Denmark Rosebud	Guernsey	3876	14–3–32	20–4–39	273	29	8,937	5·89	525·56	Denmark Research Station	Wollongbar MacQuarrie
Newstead Lovely 20th	A.I.S.	17585	19–2–34	6–5–39	273	34	12,297	4·17	513·15	W. G. Burges .	Renown of Newstead (3077)
Tipperary Beauty 2nd	do.	18314	8–9–34	1–8–39	273	21	12,003	4·19	502·72	W. G. Burgess	Blacklands Monarch's Commander (1877)
Blacklands Pretty Maid 6th	do.	9376	25–2–32	13–7–39	273	20	11,305	4·10	463·75	A. E. Grant	Orama of Blacklands (1905)
Denmark Golden Marie	Guernsey	3873	26–4–32	29–7–39	273	8	8,064	5·55	447·70	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Gold	A.I.S.	18632	31–1–34	2–7–39	273	26	11,133	4·00	445·47	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Crantock Napoleon's Duchess	Jersey	52399	11–1–34	29–9–39	273	12	8,121	5·36	435·40	R. S. Redman .	Crantock Blonde's Napoleon (8207)
Denmark Golden Dawn	Guernsey	4118	9–1–33	27–4–39	273	20	7,080	6·17	436·82	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Milkmaid 5th	A.I.S.	15339	2–1–34	5–3–39	273	26	11,058	3·93	434·75	E. T. Thatcher ...	Parkview Guardian (2557)
Lemon Grove Gladys 10th	do.	17147	14–8–33	28–6–39	273	20	11,078	3·85	426·47	Prowse Bros.	Dan of Greyleigh (97)
Lemon Grove Fussy 6th ...	do.	17144	10–5–33	20–6–39	273	17	10,551	4·00	422·73	Prowse Bros. ...	Alne Bank Lady's Gift (760)
Denmark Prosper's Rosa	Guernsey	4127	27–12–32	29–4–39	273	20	7,560	5·48	414·63	Denmark Research Station	Koojan Golden Prosper (2283)
Muresk Dessie	do.	4722	20–4–33	28–5–39	273	22	7,926	5·23	414·46	Muresk Agricultural College	Triumph of Wollongbar (513)
Illawah Lex 3rd	A.I.S.	11797	15–2–33	8–7–39	273	31	10,983	3·75	412·31	D. Bevan & Sons ...	Illawah Veteran's Hope (822)
Greenmount Sweet Lass	Jersey	44204	14–7–33	18–3–39	273	21·5	7,408	5·57	412·02	A. J. B. Strempel ..	Bellefaire Bonaparte's Bonetienne (9244)
Crantock Cream Lass	do.	43542	7–6–31	28–6–39	273	11	7,383	5·54	408·85	Mrs. G. H. Burnside ...	Crantock Starbright's Montrose (5945)
Denmark Orangebud ..	Guernsey	4123	9–8–32	17–10–38	273	24	8,892	4·42	405·32	Denmark Research Station	Koojan Golden Prosper (2283)
Wooroloo Duchess 2nd	A.I.S.	15324	15–8–32	25–6–39	273	21	10,263	3·93	405·12	E. T. Thatcher .	Triumph of Pine Creek (2515)
Beauna Vista Tiny 18th	do.	4221	24–6–30	6–6–39	273	18	10,626	3·75	398·52	Prowse Bros.	Spearfelt of Alne Bank (1029)

Milbank Joan 4th	do.	4976	7-5 31	28-8 39	210	9·5	9,39	4·22	397·05	Dunkley Bros.	Parkview Ruler (309)
Capel Glad Star	Jersey	47538	14-12-32	22 5-39	273	26·5	8,315	4·74	394·19	B. W. Prowse	Capel Carnation's Pride (7988)
Radyr Park Dorothy	do.	45844	27-7 31	25-7 39	240	15	8,010	4·88	391·10	L. Temple	Melrose Clarion (6931)
Greenmount Bonetienne's Twinklette	do.	44202	6 8-33	25-11-38	273	18·5	6,581	6·00	390·17	A. J. B. Strempel	Bellefaire Bonaparte's Bonnetienne (9244)
Muresk Lady Fair	Guernsey	4729	20-9 32	11 5 39	273	18·5	8,090	4·78	386·75	Muresk Agricultural College	Triumph of Wollongbar (513)
Brackenhurst Treasure 2nd	A.I.S.	15755	16 7 33	12-6-39	273	16	9,618	4·00	385·55	R. J. Morgan	Tipperary Royal's Re-echo (964)
Muresk Damsel	Guernsey	4720	2 11 33	28-2 39	273	22	7,701	4·97	383·07	Muresk Agricultural College	Muresk Homestead (2075)
Lansdowne Bonnie Blossom 2nd	do.	4351	6 8-33	6 8-39	273	14	7,542	4·89	374·99	J. R. Giles .	Koojan Ace's Advocate (2272)
The Wold Easter Daisy ...	Jersey	34731	5-6 31	27-4 39	273	14·5	7,004	5·34	374·00	L. C. Field	Grantham Easter King (6510)
Rosy Hill Pearl	do.	24707	5 9 25	13 9 39	273	18	7,284	5·11	372·59	M. T. Padbury .	Choice Goods of Garden Hill (4580)
Lemon Grove Gracie 11th ...	A.I.S.	17148	10 8-33	1 6 39	273	18	9,467	3·93	371·87	Prowse Bros. .	Greyleigh Archer (571)
Spring Park Starbright 2nd	Jersey	23658	17-10-26	6 5-39	273	16	6,483	5·73	371·28	M. T. Padbury	Rye Duke of Glen Iris (1994)
Leylands Tiny	A.I.S.	17181	24-2 34	25-5-39	273	15	9,795	3·77	369·29	Prowse Bros.	Parkview Commodore (306)
Illawah Limerick Lass 2nd ...	do.	5016	14-9 29	9-6-39	273	6	9,993	3·68	368·10	Prowse Bros.	Sentinel of Greyleigh (1647)
Coogely Princess	Guernsey	4103	25-11 32	4-8 39	273	15	7,335	5·00	366·60	S. F. Russell	Karridale Laddie (1440)
Devonia Starbright's Fancy	Jersey	43631	20 9 32	17-7 39	273	10	6,375	5·74	366·05	W. Padbury .	Grantham Starbright's King (5796)
Westby Lupin 3rd	A.I.S.	18156	31 8-34	16 9 39	273	10	9,443	3·83	362·02	Burkitt & Brown	Telyarup Duke (956)
The Wold Starbright Daisy	Jersey	31179	8 7 30	9 5 39	273	14	6,912	5·28	365·00	L. C. Field	Grantham Starbright's King (5796)
The Wold Starbright Grey 2nd	do.	46430	17 4 33	4 6-39	273	15	7,950	4·54	360·95	L. C. Field	Lonswood Lord Grey (7291)
Capel Noraleda	do.	56709	7-3 34	15 5 39	273	22	7,341	4·92	360·90	B. W. Prowse	Capel Carnation's Pride (7988)
Minnamurra Orvieto	Guernsey	1597	4-8 26	11-9 39	273	10	7,620	4·69	357·83	P. G. Hampshire	Minnamurra Golden Lad (402)
Tabbagong Dove 11th	A.I.S.	14421	22-7-33	25-4 39	273	12	8,376	4·26	357·26	W. G. Burges	Parkview Reward 2nd (260)
Lansdowne Lassie	Guernsey	4362	8 4 33	7-7 39	273	15	7,095	5·03	357·00	J. R. Giles .	Woodstock Ace (2118)
The Wold Northwood Grey	Jersey	42214	15-5-32	20 4 39	273	14·5	6,974	5·09	355·40	L. C. Field .	Lonswood Lord Grey (7291)
Radyr Park Clarion Call	do.	45843	5-7-31	18 8 39	273	10	6,195	5·73	355·11	L. Temple .	Melrose Clarion (6931)
Crantock Lady Buttercup	do.	39439	21-5-30	9-9-39	273	14	6,312	5·62	354·97	Mrs. G. H. Burnside .	Crantock Starbright's Montrose (5945)
Grass Vale Twylish Eve . .	do.	61960	17 10 33	7 5-39	273	16	6,378	5·53	352·55	R. H. Rose .	Banyule Silvermine's Twylish (7600)
Lemon Grove Dora 8th	A.I.S.	17141	12 12 33	10 5 39	273	18	9,234	3·80	351·90	Prowse Bros.	Dan of Greyleigh (97)
Grass Vale Golden Cream 9th	Jersey	61958	16 8 33	29-5-39	273	13	5,637	6·17	348·20	R. H. Rose	Banyule Silvermine's Twylish (7600)
Grass Vale Noramine . .	do.	48537	17 11 33	29 5-39	273	14·5	6,011	5·79	348·00	R. H. Rose	Banyule Silvermine's Twylish (7600)
Tipperary Daphne	A.I.S.	5114	5-10 30	24 7-39	273	14	8,712	3·99	347·65	B. W. Prowse	Melba's Re-echo of Darbalara (2452)
Blacklands Fairy 12th . .	do.	9301	6 5 37	10-4-39	273	20	9,060	3·82	346·45	D. Bevan & Sons .	Orama of Blacklands (1905)
Denmark Orangebud	Guernsey	4123	9 8-32	20 9-39	273	23	7,479	4·62	345·86	Denmark Research Station	Koojan Golden Prosper (2283)
Numbawarra Silky 3rd . .	A.I.S.	17626	28 8 32	25 7-39	273	16	9,190	3·75	345·03	Prowse Bros.	Jellicoe of Fairfield (1136)
Beauna Vista Jock's Tiny .	do.	9075	25-9-32	10 4 39	273	23	9,579	3·52	343·80	D. Bevan & Sons	Beauna Vista Jock (212)
Selsey Attraction	Jersey	55203	16 7 34	11 8-39	180	20	5,520	6·21	343·02	Robinson Bros.	Brampton Great Boy (imp.) (9137)
Leylands Princess	A.I.S.	12255	21 10 33	11 6-39	273	15	8,265	4·12	340·81	B. W. Prowse	Mayflower's Emblem of Hillview (955)
Westby Ulery	do.	15143	15 6 33	26 8-39	273	8	9,129	3·73	340·81	Burkitt & Brown	Telyarup Duke (956)
Lemon Grove Pride 8th ...	do.	17150	20 7 33	11 5 39	273	9	8,937	3·74	334·74	Prowse Bros.	Alne Bank Lady's Gift (760)
Denmark Prosper's Mona	Guernsey	4126	2 2-33	6 6-39	273	20·5	7,367	4·48	330·49	Muresk Agricultural College	Koojan Golden Prosper (2283)
Tabbagong Beauty-19th	A.I.S.	7502	20-12-37	7 5-39	240	14·5	8,307	3·96	329·00	A. E. Grant	Parkview Reward 2nd (260)
Blacklands Miss Tottie 4th	do.	9365	12 4-32	20 10-38	273	14	7,602	4·25	322·59	A. E. Grant	Orama of Blacklands (1905)
Radyr Park Dorothy 2nd ...	Jersey	45845	24 7 32	26-7 39	240	14·5	5,858	5·49	322·06	L. Temple	Graceful Lad of Greenmount (7292)
Karridale Girlie	Guernsey	3820	24 9 30	23 12 38	273	21	6,108	5·17	315·81	P. G. Hampshire	Minnamurra Rose Chief (1016)
Westby Lupin 2nd	A.I.S.	15139	6-9 33	17 11 38	210	30	8,100	3·81	308·25	Bayley Bros.	Telyarup Duke (956)
Summerlea Milkmaid 12th . .	do.	18130	9 5 33	20-8 39	273	5	7,080	4·32	306·14	Dunkley Bros.	Summerlea Searchlight (972)
Summerlea Milkmaid 7th ...	do.	7683	3-1 31	20-7 39	273	8	8,859	3·42	302·58	Dunkley Bros. ...	Victor of Telyarup (2498)

HERD TESTING—*continued.*

Name of Cow.	Breed.	Herd Book No.	Date of Birth.	Date of Entry to Test.	No. of Days in Test.	Milk for last Day.	Milk for Period.	Average Test.	Average Butter Fat.	Owner.	Sire.
						lb.	lb.	%	lb.		
COWS 5 YEARS AND OVER—*continued.*											
Crantock Napoleon's Primula	Jersey	56957	17 7 34	26-9-39	273	12	5,976	5·04	302·18	H. S. Redman	Crantock Blonde's Napoleon (8207)
Leylands Daphne	A.I.S.	12252	2-8 33	29-8-39	210	19	7,575	3·97	300·72	B. W. Prowse	Widgee Waa Record (848)
Denmark Prosper's Lady	Guernsey	3273	6 12-31	24–4 39	273	16	5,598	5·37	300·50	Denmark Research Station	Koojan Golden Prosper (2283)
Swanlea Radium 8th	A.I.S.	4990	17 7 31	21-5 39	273	14	8,232	3·63	299·08	Prowse Bros.	Headlight of Parkview (1406)
Blacklands Daphne 7th	do.	9291	18 10 32	5–4–39	273	20·5	8,747	3·38	295·63	A. E. Grant	Fussy's Monarch of Hill View (493)
Yanget Duchess 2nd	do.	15410	10 5 34	12 7 39	240	16	8,355	3·49	291·40	A. E. Grant	Sunrise of Parkview (1875)
Leyland's Model	do.	12254	12 8-33	13 7 39	240	9	7,740	3·76	291·31	B. W. Prowse	Widgee Waa Record (848)
Blacklands Graceful 7th	do.	9318	24-7-32	5 9 39	240	18	6,975	4·17	291·30	A. E. Grant	Orama of Blacklands (1905)
Minnamurra Currency Lass	Guernsey	2606	27 10 29	17 7-39	273	9	6,312	4·58	288·90	Muresk Agricultural College	Caramana Favour (652)
Greenmount Marinette	Jersey	34840	24 5 31	15–12–38	273	21	5,913	4·81	288·20	A. J. B. Strempel	Grantham Starbright King (5796)
Grass Vale Buttercup	do.		28 6 31	27-6 39	240	11·7	4,821	5·95	287·11	R. H. Rose	Campanile's Duke of Burekup (7287)
Blacklands Modesty 3rd	A.I.S.	9367	20 5-32	5 10 38	273	24	7,362	3·85	283·71	A. E. Grant	Emperor of Blacklands (947)
Crantock Starbright's Duchess	Jersey	39440	15 10-30	20 7 39	273	12	5,331	5·27	281·19	Mrs. G. H. Burnside	Crantock Starbright's Chief (5790)
Summerlea Red Rose 3rd	A.I.S.	14253	24 5 31	7 8 39	240	11·5	7,073	3·97	280·68	Dunkley Bros.	Summerlea Searchlight (972)
Colmyn Bubbles	Jersey	47678	21 9 33	27–8–39	273	5·5	6,047	4·58	277·20	C. H. Ironmonger	Colmyn Captain Mac (5855)
Summerlea Tulip 13th	A.I.S.	22531	14–7–34	9 8 39	240	8	7,485	3·62	270·90	Dunkley Bros.	Summerlea Togo (1527)
Garden Hill Silvermine 7th	Jersey	48173	29 9–33	20 5 39	273	10	5,145	5·18	266·39	M. T. Padbury	Glen Iris Star (9492)
Crantock Lady Primrose	do.	52398	10 6 31	23–8–39	180	21	6,015	4·41	265·11	Mrs. G. H. Burnside	Crantock Starbright's Montrose (5945)
Yanget Pendant 2nd	A.I.S.	15415	29–6–33	18 12 38	273	16	6,738	3·82	257·32	A. E. Grant	Yanget Lucky Boy (978)
Garden Hill Golden Princess	Jersey	43921	14 12–32	12-10-39	273	11	4,248	6·05	257·15	W. Padbury	Glen Iris Star (9492)
Kurrawang Nancy 5th	A.I.S.	4246	26–4 30	10 9–39	273	8	7,005	3·61	253·02	Dunkley Bros.	Standard of Cosy Camp (2695)
Colmyn Eileen	Jersey	43463	8 10 32	1 10 39	240	10	6,570	3·83	251·34	C. H. Ironmonger	Rye Duke of Glen Iris (1994)
Summerlea Beauty 7th	A.I.S.	22520	10 7-34	8–8–39	273	8·5	6,656	3·76	250 63	Dunkley Bros.	Summerlea Supreme (973)
Summerlea Dairymaid 8th	do.	14242	19–12 31	9 7–39	240	8	7,170	3·49	250·50	Dunkley Bros.	Victor of Telyarup (2498)
Glanavon Vida 2nd	do.	16495	25 5–33	28–11 38	273	24	6,180	4·05	250·29	E. T. Thatcher	Glanavon Nimrod (437)
The Wold Daisy Grey 2nd	Jersey	46428	28 3 33	1 7 39	240	5·5	4,980	4·99	249·48	L. C. Field	Lonswood Lord Grey (7291)
Moorlands Glide	do.	45237	5 8 32	15–6 39	150	25	4,740	5·23	247·74	Estate late P. Rose	Melrose Clarion (6931)
Moorlands Happy	do.	54219	30 4 33	20 3 39	150	23·5	4,605	5·34	245·58	Estate late P. Rose	Melrose Liberty (7973)
Grass Vale Golden Cream 7th	do.	44182	19 7 32	17–8 39	210	13·5	4,410	5·56	245·26	R. H. Rose	Banyule Silvermine's Twylish (7600)
Yanget Royal Lady	A.I.S.	15417	21 9 33	5 10 38	273	16	6,648	3·67	243·71	A. E. Grant	Glanavon Defender (959)
Capel Centenary Girl 3rd	Jersey	56707	3 3 34	14 8 39	210	14·5	4,875	4·95	241·29	B. W. Prowse	Capel Carnation's Pride (7988)
Lemon Grove Buttercup 25th	A.I.S.	17136	25 7 33	7 7 39	273	12	6,236	3·84	239·26	Prowse Bros.	Alne Bank Lady's Gift (760)
Summerlea Betty 3rd	do.	14239	9 3 32	18 9 39	240	6	5,655	4·10	231·87	Dunkley Bros.	Summerlea Searchlight (972)
Summerlea Hobby 11th	do.	18128	4–5 34	13 8 39	273	10	7,080	3·24	229·64	Dunkley Bros.	Summerlea Kitchener (971)
Blacklands Lady Thelma 7th	do.	9342	1 11 32	19 11 38	273	5	5,325	4·28	228·28	A. E. Grant	Parkview Limelight (370)
Grass Vale Twylish Maggie	Jersey	53029	12 6 33	12 8 39	210	12	4,565	4·89	223·31	R. H. Rose	Banyule Silvermine's Twylish (7900)
Mokine Sapphire 2nd	do.	49584	20 10 32	31 8 38	180	19	4,290	4·66	199·95	Miss L. Hancock	Juadine Sunshine (8212)
Denmark Rosa 3rd	Guernsey	2523	5-4 29	15-9 39	150	13	4,290	4·64	199·17	Denmark Research Station	Wollongbar Reformer (538)
Grass Vale Lady Fowler 16th	Jersey	44183	2-9 32	3 9 39	210	6	3,385	5·68	192·51	R. H. Rose	Banyule Silvermine's Twylish (7600)
Westby Polly	A.I.S.	15141	21–5 32	19 2 39	120	35	4,440	4·17	185·19	Bayley Bros.	Telyarup Duke (956)
Marks Villa Lottie 3rd	do.	16484	10-11 28	8-9-39	60	58·5	3,825	3·68	140·76	B. W. Prowse	Marks Villa Dina's Lad

Radyr Park Laddie's Estrellita	Jersey	45846	16 7–32	31–7–39	90	33	2.595	5·27	136·92	L. Temple	Graceful Lad of Greenmount (7292)
Moorlands Haven	do.	....	27–6–33	29 8 39	90	30·5	2.760	4·68	129·15	Estate late P. Rose	Melrose Liberty (7973)
Wooroloo Joy	A.I.S.	15333	10–4–34	28 8 39	60	50	3.300	3·91	129·06	Wooroloo Sanatorium Farm	Parkview Guardian (2557)
Capel Daisy 2nd	Jersey	34349	22 12 39	13 8 39	120	18	2.790	4·61	128·70	B. W. Prowse	Bracken Fern of Roelands (4014)
Grass Vale Lady Fowler 17th	do.	48536	6–5–33	8–5–39	60	30·5	2.190	5·19	113·55	R. H. Rose	Banvule Silvermine's Twylish (7600)
Leyland's Lady Betty ..	Guernsey	4384	26–9–32	6 8–39	60	30	2.010	4·90	98·52	S. F. Russell ..	Koojan Ace's Advocate (2272)
Blacklands Daphne 6th	A.I.S.	9290	2 11–32	19–9–39	120	8	3.765	2·53	95·34	A. E. Grant	Fussy's Monarch of Hill View (493)

Experiments in the Feeding of Phosphorus Supplements to Sheep in Western Australia.

by

E. J. UNDERWOOD, F. L. SHIER AND A. B. BECK.

Introduction.

Supplementing the diet of grazing stock with phosphorus in the form of phosphatic licks has been practised in different parts of the world for many years. It is natural that such a practice should have received considerable prominence in Australia where the soils are in general low in available phosphorus and where the climate of much of the country is characterised by long dry periods when the grazing is exceedingly poor. In Western Australia the use of phosphatic licks was of little consequence prior to 1928 when in the dry summer months the occurrence of botulism in sheep due to the consumption of rabbit bones and carcases carrying the toxin of *Clostridium botulinum* was first recognised. (Bennetts, 1933). A greatly increased use of phosphate supplements in the form of licks followed recommendations based on the classical South African work demonstrating the relation of this disease in cattle to phosphorus deficiency. Experience of farmers in Western Australia during the next few years with such licks, however, was, in general, disappointing and extensive experiments carried out in the summers of 1933-4 and 1934-5 completely failed to confirm the suggestion of phosphorus deficiency (Underwood & Shier 1935, 1936). A large consumption of a soluble phosphatic lick during two successive dry summers produced no increase in live weight of young or old sheep grazed on cereal stubbles and dry grazing typical of the areas involved and no decrease in the incidence of the pica impelling the sheep to consume infected carrion. In addition the levels of inorganic phosphorus in the blood of the sheep receiving no supplement remained at "normal" levels, though a fall in such levels is regarded as a very sensitive index of phosphorus deficiency. Further experiments (Underwood, Beck and Shier 1939) confirmed the absence of phosphorus deficiency as a primary factor in the welfare of the sheep and showed that the nutritional disabilities and the incidence of the pica were largely a reflection of the inadequate amounts of available protein and energy supplied by the dry summer grazing

During this time the idea of the existence of extensive phosphorus deficiency in grazing sheep in Australia was seriously challenged by the work of the Division of Animal Nutrition of the C.S. & I.R. in South Australia. Studies on the phosphorus requirement of the growing Merino were carried out (Martin and Pierce, 1934) and experiments with growing lambs depastured on phosphorus-deficient country at Dismal Swamp in South Australia failed to show any benefits on growth or wool yield from the use of phosphatic supplements. The consumption of these supplements, however, was quite low. (Marston & Lines, 1934). Furthermore, Marston (1935) has pointed out that successful results from the use of phosphorus supplements with cattle grazing on phosphorus low country do not necessarily mean that similar results will be obtained with sheep grazing under the same conditions. The lower skeletal proportions of sheep and the higher food consumption per unit live weight would enable sheep to fulfil their phosphorus requirements from herbage with a considerably lower concentration of P. than cattle.

The need for further field experimentation on this matter therefore became imperative and towards the end of 1935 the C.S. & I.R. decided to initiate experiments in the Eastern States with the object of obtaining a direct answer to the question as to the conditions under which the use of phosphatic licks for sheep might or might not be justified. In the same year the Department of Agriculture in Western Australia decided to conduct experiments in two places along closely similar lines to those laid down by the C.S. & I.R. and in co-operation with them. This was done so that the earlier work on the use of phosphatic licks, already mentioned as having been carried out in Western Australia, could be extended and at the same time a direct comparison of the results be made with those obtained in other parts of Australia. The present paper records the technique and results of these experiments.

Location of Experiments.

It was decided to carry out the experiments at the Merredin and Wongan Hills Research Stations which experience seasonal conditions typical of a large part of the agricultural areas of Western Australia, with the exception of the extreme south-west corner of the State. These conditions are characterised by a mild, moist winter and spring when virtually all the effective rainfall occurs and plant growth takes place and a hot, dry summer of about six months duration when there is usually little rainfall and no crop or pasture growth. The definite seasonal incidence of the rainfall is clearly shown in Table 1 where the mean monthy rainfall figures for Merredin and Wongan Hills are given.

Table 1.

MONTHLY RAINFALL FIGURES.

——	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Merredin	42	48	96	96	155	201	215	159	105	88	45	53	1,303
Wongan Hills	38	57	89	78	193	288	264	213	110	81	41	42	1,494

For six months of the year therefore sheep in these areas have to subsist on dry grazing consisting of cereal stubbles and poor annual pasture species which become progressively poorer in quantity and quality as the summer advances. The seasonal variation in the composition of such herbage and especially its extremely low nutritive value in the late summer and early autumn prior to the first effective rains has been shown by Underwood, Shier and Harvey (1937). The phosphorous content of samples of the dry grazing, selected to conform as far as possible to the material actually consumed by the sheep, was found by these workers to fall from about 0.12 per cent. P. on the dry matter in the early summer to as low as 0.07 per cent. P. at the end of the summer period. Supplementary feeding of the sheep with fodders, principally cereal hay and grain, grown in the previous year is widely but not universally practised.

The Merredin Research Station is situated about 160 miles east of Perth towards the eastern and drier end of the wheat belt. Its soils are principally brown clay-loams with calcareous clay subsoils similar to much of the forest soils of the eastern wheat belt. These soils must be considered of high fertility on Western Australian standards.* Excellent cereal crops can be grown on these soils with the use of superphosphate. The Wongan Hills Research Station is situated about 90 miles north-east of Perth on sandy soils typical of the better

* The majority of W.A. soils are, according to Teakle (1937-8) exceptionally low in phosphate of low availability.

class lateritic sand plain which occurs throughout the agricultural areas. The soil is acid in reaction, non-calcareous, and of exceedingly low initial fertility. Quite good cereal crops, however, can be grown in these soils with the use of adequate superphosphate, though in its absence practically no yield at all is obtained.

Experimental Procedure and Layout.

Merredin.

Early in January, 1936, 150 mated merino ewes were divided into two even groups by drafting, care being taken to ensure an equal age distribution in each group. These sheep had all had access to a phosphatic lick known as Dicalcic Lick* for the previous few weeks. One of the groups (A) was then given access to Dicalcic Lick and the other group (B) to common salt exposed in covered wooden troughs. Until 29/4/36 it was necessary to run these together as one flock and to separate for about 8 hours on three days of each week when they were given access to their appropriate supplements. Thereafter the two groups were run in separate paddocks and alternated weekly. The licks were continuously available and the consumption measured by weekly weighings of the troughs. All the ewes were weighed at approximately fortnightly intervals.

In the late summer the grazing became so poor that a small supplement of wheaten hay at the rate of ¾ lb. per head per day was fed to the ewes in both groups during May and June. Some measure of hand feeding is generally necessary in these areas during the late summer and autumn prior to the advent of green feed, particularly for pregnant and lactating ewes. In the present experiments is was thought necessary to keep such feeding to a minimum and by May a number of pregnant ewes and lambs had been lost. The very poor nutritive conditions were responsible for the loss of 30 lambs as well as a number of pregnant ewes. Lambing commenced on 6/4/40. Only 40 lambs survived from Group A and 45 lambs from Group B so a further 54 ewes were added to each group to give more effective numbers for carrying on the experiment in subsequent years. After allowing for deaths and culling in the original flocks this gave two new groups of 120 ewes in Group A and 117 ewes in Group B.

These two groups were mated in December, 1936, and given access to dicalcic lick and to salt during the 1936-7 summer and autumn as in the previous year. The two groups were grazed together and given access to the appropriate lick three times weekly until January 8th, when suitable separate paddocks became available. For a period of one week the phosphate was given to Group A in the form of neutral sodium phosphate drench at the rate of 2.3 gm. P three times weekly and the salt to Group B in a drench supplying the same amount of sodium as Group A. Owing to practical difficulties the drenching was discontinued with the ewes and the procedure of placing the licks in troughs adhered to. The drenching method was used throughout for the 1936 drop lambs and was also used later in the treatment of the 1937 drop lambs.

Lambing commenced in April, 1937, as in the previous year. Weighing of the ewes was discontinued during the lambing period as the continuous mustering and drafting, etc., was responsible for some of the losses in the previous year. The grazing conditions were not so poor in the late summer as in 1936, but a severe wind storm at the end of February blew away a large proportion of the dry grazing of the stubble paddocks, necessitating hand feeding of the

* The Dicalcic Lick contained common salt 38%, molasses 5%, phosphoric acid (P_2O_5) 18% of which 90% was present as dicalcic phosphate.

ewes in both groups during May with about 1 lb. of wheaten hay per head per day, and small amounts during June. The lambs from each group were ear-tagged, weighed fortnightly and given phosphate or salt according to whether they were in Group A or B. The supplements were not given in the period approximately June-November in any year, since the grazing was at its best at this time and supplying relatively large amounts of phosphorus. The actual periods during which the feeding of lick and salt and the drenching was carried out is indicated on the graphs of the live-weights of the different groups.

In November, 1937, the weighings of the original groups of ewes (the mothers of the 1936 and 1937 drop lambs) was discontinued and the experiment continued until the end of 1939 with the young sheep only.

Wool yields (i.e., fleece weights) were obtained individually from the sheep at the ordinary shearing time in each year. The yields for the mature ewes are given for 1936 and 1937; for the 1936 drop lambs for 1937, 1938 and 1939, and for the 1937 drop lambs for 1938 and 1939.

Wongan Hills.

At Wongan Hills the layout and procedure was the same except that in both 1936 and 1937 the ewe groups were grazed in separate paddocks (which were alternated frequently) with their appropriate licks. In 1936 there were 73 ewes in each group which were increased to 150 in 1937. In 1936, for similar reasons as at Merredin, lamb and ewe losses were high. Thirty-two lambs were tailed from A Group and 27 from B group. Only small amounts of hay were fed during May and early June. In 1937, with better summer grazing, a ration of 1 lb. of cereal hay during late April and May and less handling, a better lambing resulted; 112 lambs were tailed from Group A and 109 from Group B.

The progeny, both 1936 and 1937 drop, were drenched as at Merredin. The periods of such drenching are indicated on the graphs of their live weight.

Lick Consumption.

In 1936 and 1937 the phosphatic lick, containing 18% P_2O_5 very largely as dicalcic phosphate, was made available to the ewes of Group A at both Merredin and Wongan Hills during the periods of poor grazing. Salt alone was made available to the ewes of Group B. The lick was found very palatable and consumed at Merredin at the rate of approximately 4 ozs. per head per week during this period, both in 1936 and 1937. This amount of lick supplied 1.4 gm. of P per day to the sheep. At Wongan Hills the average consumption during this period was 5 ozs. or 1.8 gm. P per sheep per day in 1936 and approximately 4 ozs. or 1.4 gm, P per sheep per day in 1937. The consumption of lick and salt was very regular throughout the period of dry grazing but fell quickly to negligible quantities with the advent of green feed. Lick feeding was discontinued each year when this fall occurred.

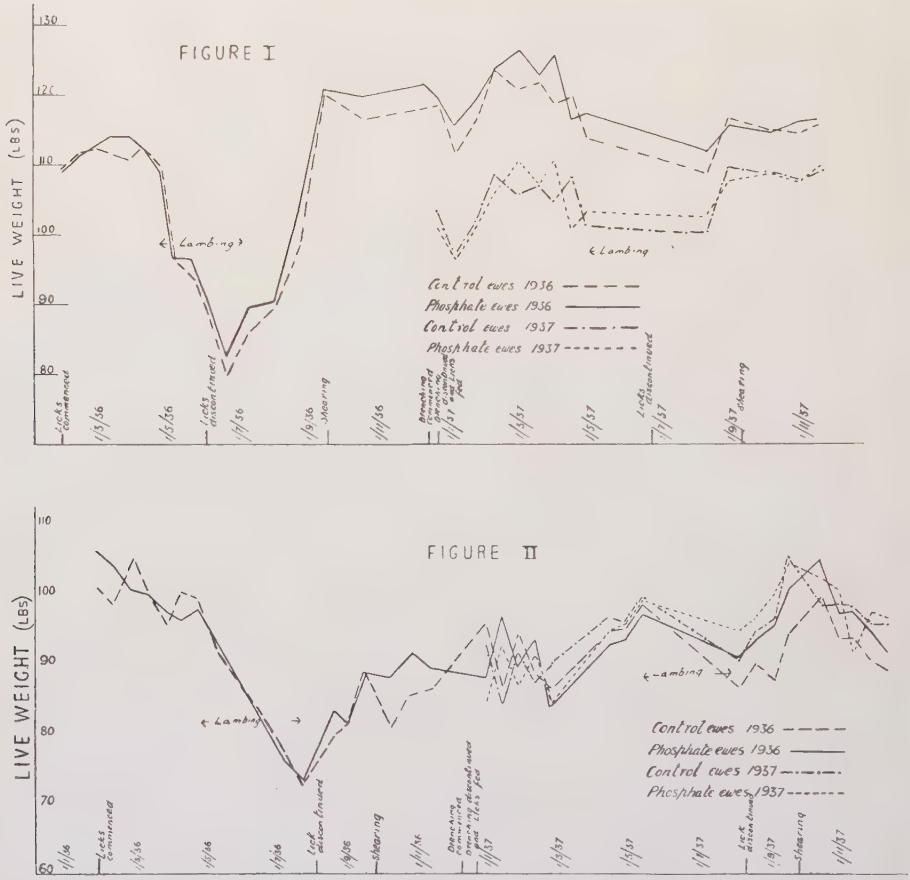
The salt was consumed by the ewes of Group B at the rate of 3 to 3.5 ozs. per head per week at Merredin and at 4 to 4.5 ozs. per head per week at Wongan Hills in both years.

As stated earlier the lambs from the phosphate fed ewes were not given lick but were dosed three times weekly from January to June in each year with a sodium phosphate drench supplying 2.3 gm. P per dose. The control lambs were dosed with a solution of common salt supplying equivalent amounts of sodium.

Body Weights of the Ewes.

The mean fortnightly body weights of the Merredin ewes are presented graphically in Figure I, and of the Wongan Hills ewes in Figure II.

The graphs are to a large extent self-explanatory. It is quite obvious that the phosphate fed sheep have not maintained significantly higher live weights than those receiving salt only. The very large falls in weight during April-June, 1936, are accounted for by the combined effects of the losses due to lambing and



Graphs showing the mean fortnightly live weights of the experimental ewes at Merredin (Fig. I) and Wongan Hills (Fig. II).

the exceptionally poor grazing conditions at this time. It will be noted that the falls during the same period are not nearly so great in the 1937 season, either at Merredin or Wongan Hills, although, owing to no weighing being carried out during the 1937 lambing, the lowest level at the peak of lambing is not recorded. In this connection it should be mentioned that a comparison of the mean live weights of the two groups at these times as depicted in Figures I and II is not strictly accurate since it involves the assumption that either all the ewes in each group, or the same proportion in each group, have lambed. This is not so, but

the lambing percentages in Groups A and B, both in 1936 and 1937, at Merredin and at Wongan Hills, are not sufficiently different to appreciably affect the comparison. For simplicity, therefore, the groups are compared as a whole.

Lambing Results.

Details of the lambing results are presented in Tables 2, 3 and 4 and call for little comment. The proportion of lambs dropped to ewes mated is normal in the 1937 season at both Merredin and Wongan Hills. In the 1936 season at both places the losses at lambing time were very heavy for reasons mentioned previously and in consequence the lambing percentages, as expressed on the basis of the lambs tailed, is much lower than in 1937. In 1936, 16 lambs died at birth in each group at Merredin, whilst at Wongan Hills in all 29 were found dead in the paddocks, but no record was kept of the number from each group.

At both stations the 1936 drop ewe lambs were mated at the end of 1938, the results of which are shown in Table 4. Little importance can be attached to these results, however, owing to the small numbers of ewes involved.

At Wongan Hills in December, 1939, the 1936 drop ewe lambs were again mated, together with the 1937 drop ewes. From 64 phosphate ewes 48 lambs were tailed, or 75% and 44 lambs from 53 control ewes, or 83%.

Table 2.

LAMBING RESULTS—1936.

	Merredin.		Wongan Hills.	
	Phosphate.	Control.	Phosphate.	Control.
No. of ewes mated	75	75	73	73
No. of lambs dropped	61	63	*	*
Percentage lambing	81	84	*	*
No. of rams tailed	22	22	12	13
No. of ewes tailed	23	27	20	14
Percentage of lambs tailed	60	65	44	37

*4 lambs killed by foxes and 25 found dead but the number from each group was not recorded.

Table 3.

LAMBING RESULTS—1937.

	Merredin.		Wongan Hills.	
	Phosphate.	Control.	Phosphate.	Control.
No. of ewes mated	121	117	150	150
No. of lambs tailed	93	87	114	114
Percentage of lambs tailed	77	74	76	76
No. of wethers at weaning	40	46	52	57
No. of ewes at weaning	52	40	57	50

TABLE 4.

LAMBING RESULTS—1939.

	Merredin.		Wongan Hills.	
	Phosphate.	Control.	Phosphate.	Control.
No. of ewes mated	19	21	16	11
No. of ewes died before lambing ...	2	...	...	...
No. of lambs born	13	17	15	9
Percentage lambing	68	81	94	82
No. of lambs tailed	11	15	14	9

It is apparent that the phosphate has had no effect on the lambing percentages. The small differences apparently in favour of the controls at Merredin in 1936 and of the phosphatic group at Merredin in 1937 and Wongan Hills in 1936 are not significant. The difference of 8% at Wongan Hills in favour of the control group at the 1940 lambing of the 1936 and 1937 ewe progeny is also not significant. The proportion of ewe to ram lambs born in each group is variable at the two centres and also in different years, and it is obvious that there is no difference between the groups in this respect. No effect of the phosphate feeding on the proportion of ewes or rams surviving to weaning is evident.

The birth body-weights of the 1936 lambs at Merredin only were obtained. The mean birth weights of both the ewe and ram lambs are almost identical both within and between treatments. Thus in the phosphate group the mean birth-weight of the ram lambs was 8.3 lbs. and of the ewe lambs 8.4 lbs. The corresponding figures for the controls was 8.1 lbs. and 8.2 lbs. respectively. It is apparent that the phosphate supplement consumed by mothers during the gestation period when the grazing was at its worst has produced no improvement in the development of the lamb in utero.

Growth of Lambs.

The growth of the 1936 lambs until the middle of 1939 is presented in graphical form in figure III for the Merredin lambs and in figure IV for the Wongan Hills lambs. The mean live-weights for the ewes and the wethers in each group are graphed separately in each case. The wethers are consistently heavier than the ewes throughout, particularly at Wongan Hills, both in the groups receiving the phosphate and those receiving salt only.

At Merredin it is apparent that up to July 1938 there is no difference between Groups A and B, either in the case of the ewes or the wethers, since the lines representing the mean weights touch and overlap at a number of points. For the first few months of 1938 the wethers of Group A (phosphate) appear to be slightly heavier than those of Group B but the difference is not significant and can be shown to be due to chance alone. In July 1938 the wethers were discarded and the subsequent growth of the ewes only is recorded. For the following twelve months the phosphate appears to have produced and maintained higher live-weights compared with the ewes receiving the salt supplement only. At no point, however, do the mean differences approach statistical significance such as could be attributed to the effects of the treatment, i.e. the feeding of phosphate. It should be emphasised that the groups are small at this stage (Group A, 19, Group B, 21) and the individual variation in live weight large.

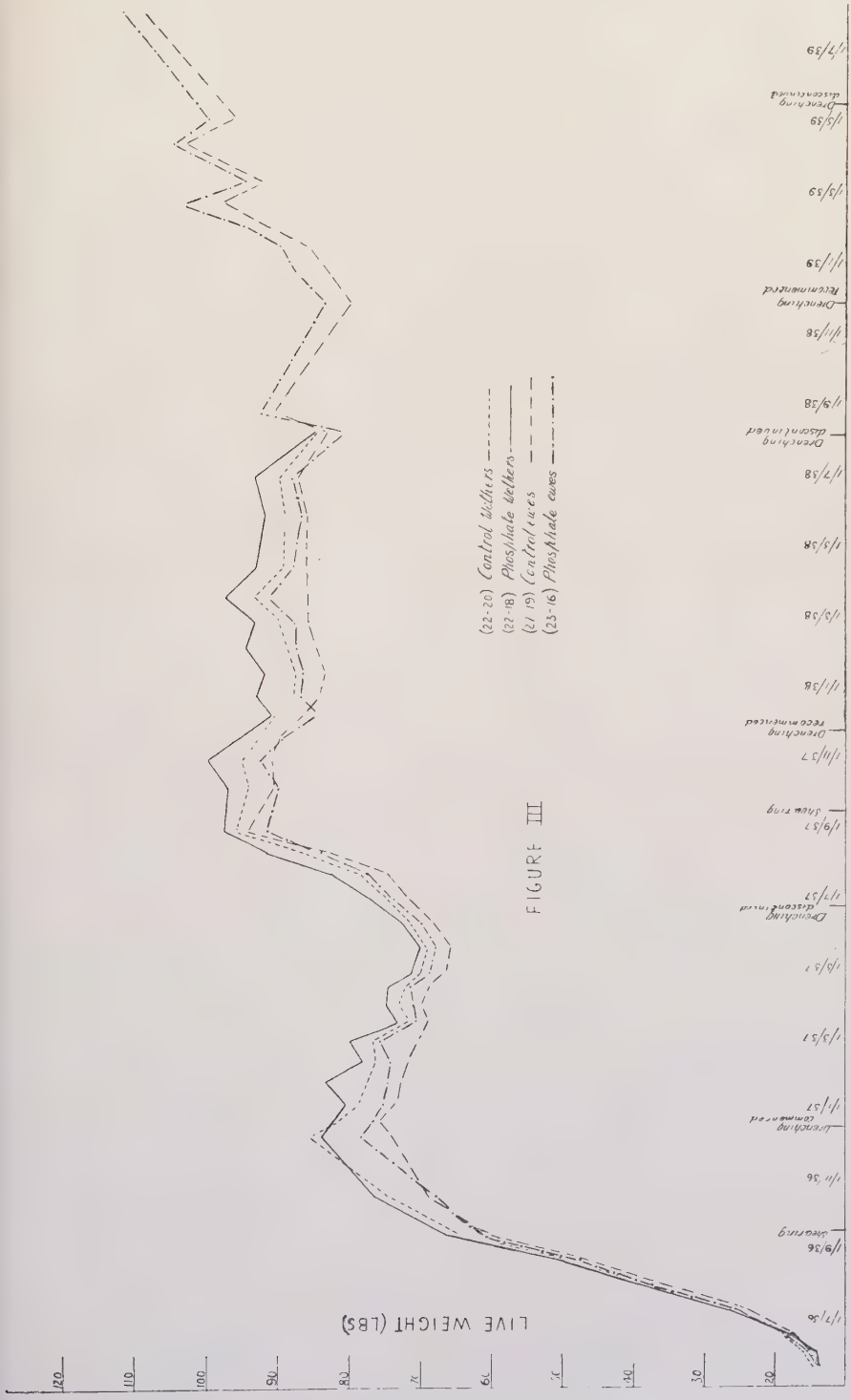


Figure III.
Graph showing the mean fortnightly live weights of the 1936 drop lambs at Merredin. The number of sheep in each group is shown in brackets.

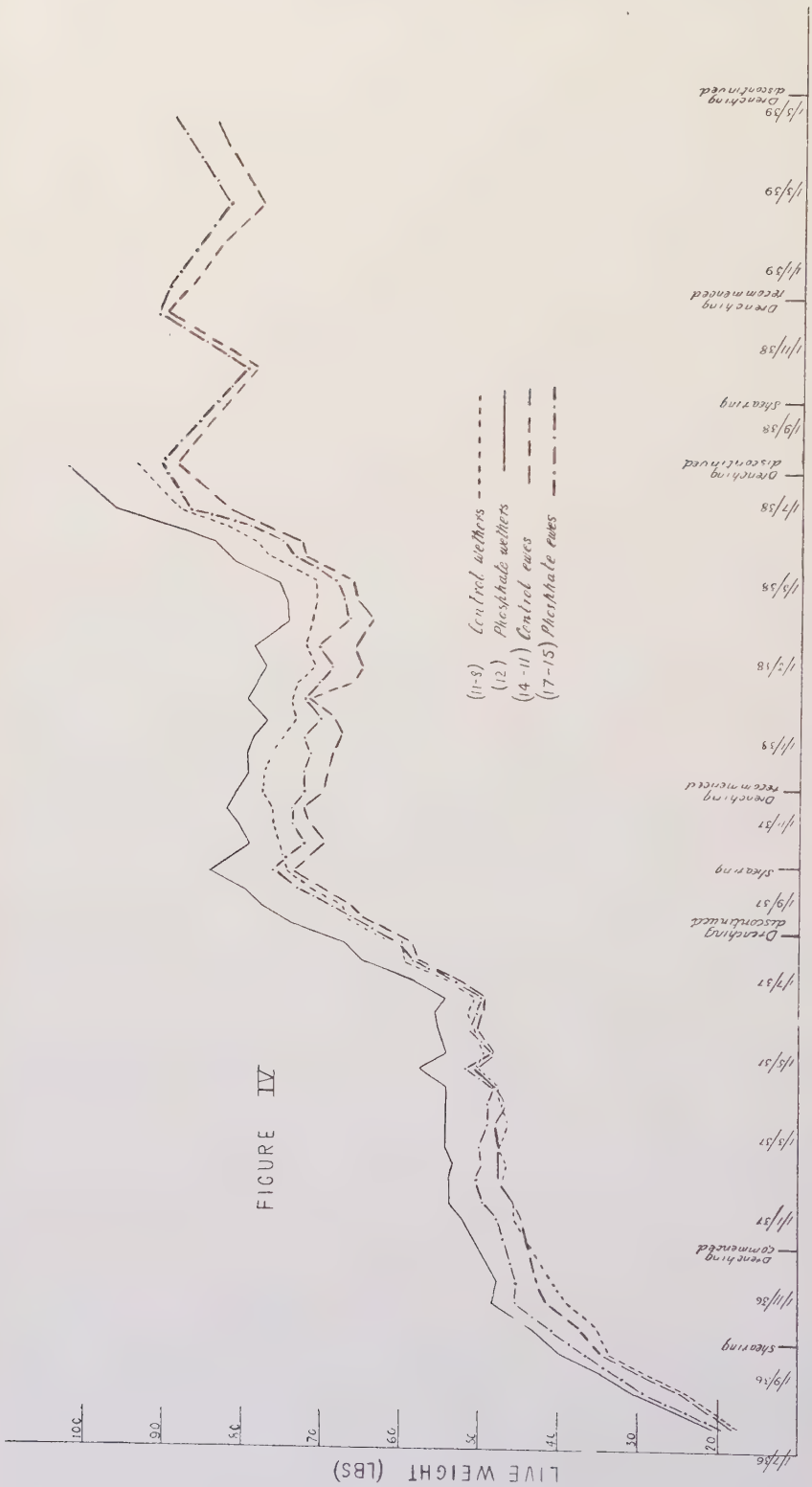
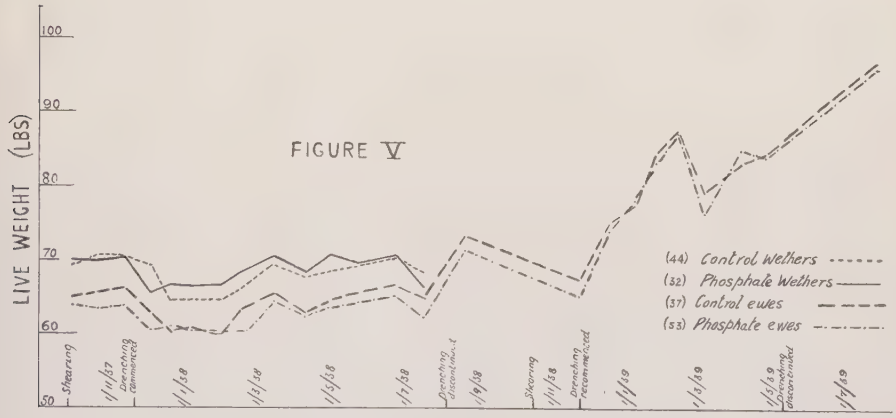
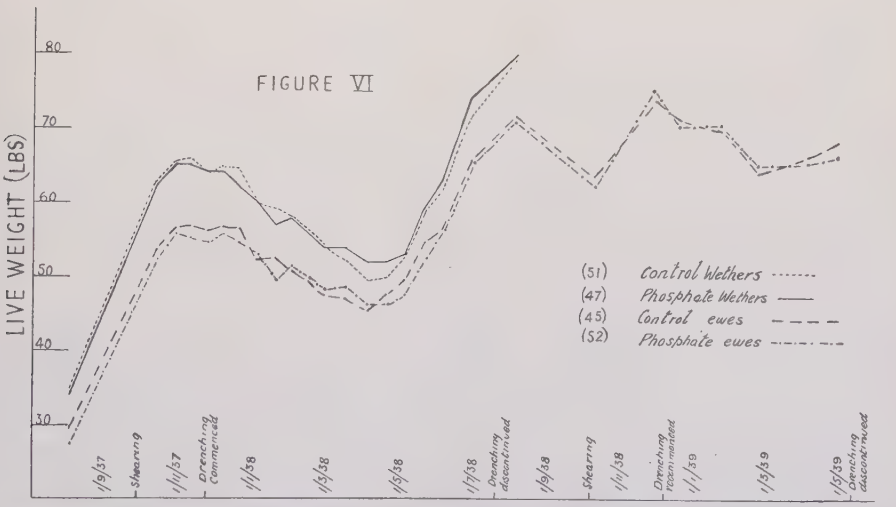


Figure IV.
Graph showing the mean fortnightly live weights of the 1936 drop lambs at Wongan Hills. The number of sheep in each group is shown in brackets.

At Wongan Hills (Figure IV) the position is very similar throughout, except that at several weighings between September 1937 and August 1938 the wethers of the phosphate fed group are significantly higher in mean live weight than the wethers of the salt group. This is very hard to understand and it is difficult to avoid the conclusion that some factor or factors other than the treatment is influencing these particular results. Neither during this period nor at any other time does the growth of the ewes show any significant response to the phosphate while the growth of neither ewes nor wethers of the 1937 drop lambs is affected by the treatment.

The growth of the 1937 drop lambs from September 1937 to August 1939 at Merredin is presented graphically in Figure V and from July 1937 to April 1939 at Wongan Hills in Figure VI. As before the mean live weights of the ewes and wethers in each group are graphed separately. Again the wethers in each group are consistently and significantly heavier than the ewes both at Merredin and Wongan Hills.





Graphs showing the mean fortnightly live weights of the 1937 drop lambs at Merredin (Fig. V) and Wongan Hills (Fig. VI). The number of sheep in each group is shown in brackets.

From the point of view of the effects of the phosphate supplements, neither Figure V nor Figure VI call for much comment. The mean live weight figures for both ewes and wethers are closely similar in Group A (phosphate) and Group B (salt) throughout the experiment. It should be noted that the graphs of the 1937 drop lambs represent the mean of twice the number of ewes or wethers (40-50 in each case) as is the case in the graphs of the previous years' lambs. This is of obvious importance where averages are being used as a basis for comparison and should be particularly borne in mind when considering the 1936 drop lambs at Wongan Hills shown in Figure IV. It is exceedingly doubtful if the apparent differences in the mean live weights of Groups A and B which show up at certain times in this graph would have been evident if larger groups had been used

A fact of some importance which emerges from Figures III, IV, and VI, is that the early growth of the lambs, i.e. from the first weighing shortly after birth up to weaning at 4-5 months of age, does not appear to have been affected by the treatment of the mother with respect to the phosphate supplement. This indicates that the milk yield of the ewes has not been influenced by the feeding of phosphatic lick during pregnancy in the preceding summer period, since the rate of growth of lambs up to 3-4 months of age is known to be controlled by the milk yield of the mothers.

Wool Production.

The yields of greasy wool were obtained at both Merredin and Wongan Hills from the ewes in 1936 and 1937 and from the young sheep (1936 and 1937 drop lambs) in 1937, 1938 and 1939. The yields from the 1936 or the 1937 drop lambs were not recorded in the year of their birth as they were only a few months old at shearing time. (September in each year). Machine shears were used and each fleece weighed individually with its belly, prior to the usual skirting. The total weight of locks for each group (prior to skirting) was obtained and the average figure added to the fleece and belly weight of each sheep.

No attempt to measure the yields of cleaned, scoured wool or of the spinning counts of the wool was made.

The Merredin wool results are presented in Tables 5, 6 and 7 and the Wongan Hills figures in Tables 8, 9, and 10. The results for ewes and wethers are presented separately, though no consistent differences in yield between them are apparent. In the 1937 shearings presented in Tables 6 and 9, however, the wethers have produced considerably and significantly more than the ewes both in the phosphate and the control groups. This difference appears to be associated with the rather heavier weights of the wethers at this time. It is noticeable that at the 1938 shearings there is no difference of this magnitude in favour of the wethers.

Table 5.

WOOL YIELDS—MERREDIN EWES.

Group.	1936.			1937.		
	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.
		lbs.	lbs.		lbs.	lbs.
Group A (Phosphate)	73	10·2	121	114	11·5	112
Group B (Controls)	70	9·9	120	111	11·7	113

TABLE 6.

WOOL YIELDS—MERREDIN 1936 DROP LAMBS.

Group.	1937.			1938.			1939.	
	No. of Sheep.	Mean Cut per Head.	Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.	Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.
		lbs.	lbs.		lbs.	lbs.		lbs.
Phosphate Ewes	19	12·1	91	19	13·3	92	17	13·2
Control Ewes	22	12·0	91	21	13·0	90	19	13·3
Phosphate Wethers	18	13·3	97	17	12·9	....	....	....
Control Wethers	20	13·3	94	21	12·8	....	....	....

TABLE 7.

WOOL YIELDS—MERREDIN 1937 LAMBS.

Group.	1938.			1939.	
	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.
		lbs.	lbs.		lbs.
Phosphate Ewes	52	11·1	72	52	12·7
Control Ewes	37	11·1	73	36	13·5

TABLE 8.

WOOL YIELDS—WONGAN HILLS EWES.

Group.	1936.			1937.		
	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.
		lbs.	lbs.		lbs.	lbs.
Group A (Phosphate)	72	8·8	89	138	9·3	102
Group B (Controls)	69	8·8	89	139	9·2	100

TABLE 9.

WOOL YIELDS—WONGAN HILLS 1936 LAMBS.

Group.	No. of Sheep.	Mean Cut per Head.	Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.	Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.
		lbs.	lbs.		lbs.	lbs.		lbs.
Phosphate Ewes	16	7·6	77	16	10·1	91	16	7·8
Control Ewes	11	7·4	73	12	10·4	89	11	8·6
Phosphate Wethers	12	8·3	84	12	11·0	103	....	....
Control Wethers	8	8·0	74	8	10·0	94	....	....

TABLE 10.

WOOL YIELDS—WONGAN HILLS 1937 LAMBS.

Group.	1938.			1939.	
	No. of Sheep.	Mean Cut per Head.	Mean Live Weight before Shearing.	No. of Sheep.	Mean Cut per Head.
		lbs.	lbs.		lbs.
Phosphate Ewes	53	8·6	71	51	7·8
Control Ewes	47	9·0	72	44	8·0
Phosphate Wethers	45	9·6	80	....	....
Control Wethers	47	9·2	79	..	

It is evident from Tables 5 and 8 that the mature ewes of the phosphate groups have not produced any more wool than the controls in either year or at either place. In general the results were similar for the young ewes and wethers, though the mean group values are more variable. Thus the 1936 control wethers at Wongan Hills have a mean yield of 1.0 lb. lower than the phosphate wethers at the 1938 shearing, whilst at the 1939 shearing the control ewes have a mean yield of 0.8 lb. heavier than the phosphate ewes. At Merredin the control and the phosphate fed ewes from the 1937 drop lambs showed no difference in mean yield at the 1938 shearing but at the 1939 shearing the controls yielded an average of 0.8 lb. more wool per head. Such fluctuations are a reflection of the small size of the groups and the considerable individual variation within the groups. Statistical treatment of the results shows that in no case can such mean group differences as do occur be considered significant.

Blood Phosphorus Levels.

The level of inorganic phosphorus in the blood of sheep has been shown by numerous workers to be a very sensitive index of phosphorus deficiency. Earlier studies carried out in this State in connection with the botulism investigations previously mentioned (Underwood and Shier 1935, 1936) had shown that no falls in these levels below "normal" values occurred in the experimental sheep, even in the late summer and autumn after several months on poor, dry grazing. It was considered advisable however, to extend these findings in the present experiments especially in view of the longer period, and the more severe nutritive conditions. Accordingly periodic determinations of the blood inorganic phosphorus levels were carried out on small groups (8-20 sheep) selected at random from the whole groups under treatment. As blood phosphorus levels may show large diurnal variations, the following precautions were adopted to ensure that all the figures were comparable; the bleeding was done during the same period of each day, A's and B's were bled alternatively, rumination was prevented while the sheep were in the yards, and the A group received no phosphate for at least 18-24 hours before testing. The blood samples were taken from the jugular vein and up to the end of 1936 the inorganic phosphorus content was estimated by the method of Malan and Van der Lingen (1931) thereafter the method of Fisk and Subbarow (1925) was used. In order to conform with other published results the values are calculated on the assumption that the trichloracetic acid precipitate occupies a negligible volume. Actually this involves an error of 9% since it has been shown by Thivolle and Laugier (1938) that the precipitate contains an appreciable amount of "bound" water.

The results are set out in Tables 11-16. Only group means at each sampling are given, together with standard errors and differences necessary for significance between date means.

BLOOD INORGANIC PHOSPHORUS LEVELS (mg. P. per 100 mls.).—MERREDIN.

TABLE 11.

MATURE EWES.

Date	20-2-36	26-3-36	8-5-36	2-7-36	8-1-37	18-3-37	30-7-37	27-8-37	11-11-37*	Treatment Mean.
Controls — Mean	3·40	3·82	4·08†	3·98‡	4·19	4·11	2·41‡	2·39‡	4·23	3·55
Phosphate Group — Treatment	Phosphate Fed.			Grazing only	Phosphate Fed		Grazing only			
Phosphate Group — Mean	3·37	4·10	4·42†	4·06‡	4·89	4·11	2·49‡	2·32‡	4·38	3·72
Date Mean	3·39	3·96	4·25†	4·02‡	4·54	4·11	2·45‡	2·36‡	4·30	3·64

* The results of 11–11–37 not included in statistical treatment or in "Treatment Mean" as only a small group tested on this date. † Lambing period. ‡ Lactation period.

Standard Error for Mean of Dates = ± 0·1637. Difference for Significance (P = 0·05) = ± 0·322.

TABLE 12.

1936 DROP LAMBS.

Date	30-7-37	11-11-37	13-1-38	24-3-38	16-6-38	3-11-38	29-3-39	18-4-39*
Controls — Mean	4·80	4·47	4·20	4·60	4·13	4·69	3·11	3·26
Phosphate Group — Treatment	Phosphate Fed	Grazing only	Phosphate Fed			Grazing only	Phosphate Fed	
Phosphate Group — Mean	4·64	4·33	4·67	4·63	4·53	4·44	2·71	3·47
Date Mean	4·72	4·40	4·43	4·62	4·33	4·56	2·91	3·36

Ewes and wethers 30–7–37 to 16–6–38. No significant difference between treatments or dates.

* During lambing. Ewes only 3–11–38 to 18–4–39. Results not analysed statistically as only a small group tested.

TABLE 13.

1937 DROP LAMBS.

Date	13-1-38	24-3-38	16-6-38	Treatment Mean.	3-11-38	29-3-39	18-4-39	Treatment Mean.
Controls — Mean	4·30	5·20	4·66	4·72	5·14	3·42	4·30	4·28
Phosphate Group — Treatment	Phosphate Fed			....	Grazing only	Phosphate Fed		..
Phosphate Group — Mean	4·85	4·96	5·53	5·11	4·82	3·32	4·15	4·10
Date Mean	4·57	5·08	5·09	4·92	4·98	3·37	4·23	4·19

Ewes and wethers 13–1–38 to 16–6–38. Standard Error for Mean Dates = ± 0·1894. Difference for Significance (P = 0·05) = ± 0·38.

Ewes only 3–11–38 to 18–4–39. Standard Error for Mean of Dates = ± 0·1509. Difference for Significance (P = 0·05) = ± 0·30.

BLOOD INORGANIC PHOSPHORUS LEVELS (mg. P. per 100 mls.)—WONGAN HILLS.

TABLE 14.

MATURE EWES.

Date		13-2-36	19-3-36	30-4-36	9-7-36	14-1-37	16-4-37	23-7-37	9-11-37*	Treatment Mean.
Controls .... Mean		3·89	4·62	3·61†	4·01‡	4·42	4·04	3·10‡	3·03‡	3·96
Phosphate Group	Treatment	Phosphate Fed.							Grazing only	. .
	Mean	5·19§	4·33	3·65†	3·64‡	4·14	3·72	3·05‡	3·04‡	3·96
Date Mean		4·54	4·48	3·63†	3·82‡	4·28	3·88	3·07‡	3·04‡	3·96

* The results of 9–11–37 not included in statistical treatment or in "Treatment Mean," as only a small group of sheep tested on this date.

† Lambing period.

‡ Lactation period—majority of sheep dry on 9–11–37.

§ These sheep bled in afternoon ; had access to phosphate lick in morning.

Standard Error for Mean of Dates = ± 0·2035. Difference for Significance (P = 0·05) = ± 0·401.

TABLE 15.

1936 DROP LAMBS.

Date		15-4-37	22-7-37	9-11-37	20-1-38	22-3-38	5-7-38*	9-11-38	28-3-39	Treatment Mean.
Controls .... Mean		5·05	4·97	4·26	4·16	5·19	5·25	5·19	4·25	4·80
Phosphate Group	Treatment	Phosphate Fed		Grazing only	Phosphate Fed.			Grazing only	Phosphate Fed	. .
	Mean	4·96	5·62	4·21	4·61	4·86	5·00	4·81	4·35	4·79
Date Mean		5·06	5·30	4·24	4·39	5·02	5·12	5·00	4·30	4·80

* Ewes and wethers tested up to and including 5–7–38 ; ewes only after that date. Results treated statistically as one group.

Standard Error for Mean of Dates = ± 0·223. Difference for Significance (P = 0·05) = ± 0·442.

TABLE 16.

1937 DROP LAMBS.

Date		20–1–38	22–3–38	5–7–38*	9–11–38	28–3–39	Treatment Mean.
Controls .... Mean		4·12	5·06	5·63	5·13	4·23	4·83
Phosphate Group	Treatment	Phosphate Fed			Grazing only	Phosphate Fed	....
	Mean ...	4·26	4·27	5·59	5·36	5·00	4·90
Date Mean		4·19	4·66	5·61	5·24	4·61	4·86

* Ewes and wethers tested up to and including 5–7–38 ; ewes only after that date. Results treated statistically as one group.

Standard Error for Mean of Dates = ± 0·195. Difference for Significance (P = 0·05) = ± 0·39.

It will be seen that there is no significant difference between controls and the sheep receiving phosphate; it is true that on certain dates the phosphate groups show significantly higher figures than the controls, but this is apparently quite fortuitous as at other times the controls show significantly higher figures than the phosphate group. The values obtained for the control sheep (except during the lambing and lactating period) all fall within the values of "normal" sheep and do not fall to levels which would indicate a phosphorus deficiency.

The only differences which are significant are those between dates, and here the main causes seem to be those associated with lambing and lactation. As has been pointed out elsewhere (Underwood and Shier, 1936) these two factors seem to produce rather uncertain results. For example, at Merredin in 1936 the effect of lambing and lactation seemed to have no effect on the blood phosphorus levels of the ewes; in 1937 lactation produced a large fall which persisted until at least the end of August; in 1938 some unpublished experiments on another group of ewes showed some low levels which, however, returned to normal before the middle of June. The reason for these variable falls is at present obscure and is deserving of further investigation. It should be noted, however, that they occur during the period of the year when the grazing is supplying most phosphorus. Moreover, the controls and the phosphate ewes appear to reduce their blood inorganic phosphorus levels to about the same extent.

Discussion.

Most of the significant points have been discussed to a certain extent in the sections dealing with the results of particular aspects of the experiments. These aspects dealt with the effects of a readily available phosphorus supplement on the body-weights of mature ewes, on the growth of lambs from these ewes, on the birth weights of lambs and the numbers of lambs dropped, on the wool production of both the mature and growing sheep and on the blood inorganic phosphorus levels. In all these phases of the work the results are consistently and overwhelmingly against any evidence of phosphorus deficiency or of any benefit, economic or otherwise, accruing from the use of phosphatic licks. It is true that there is an apparent improvement in the growth of the wethers of the 1936 drop lambs for a time during the 1937-38 season at Wongan Hills but, as pointed out earlier, no such effect was apparent at this time with the ewes born at the same time and carried under identical conditions, or with the 1937 drop lambs (ewes or wethers) either during this same period or in subsequent years. In the case of the 1937 drop lambs it would be expected that any benefit from the use of a phosphate supplement would show up more readily than in the case of the 1936 lambs, since the mothers of half of such lambs (1937 drop) had, in the case of the "B" group, had two successive summers without any extra phosphorus, one of them exceptionally severe, whereas in the previous year the mothers of the 1936 drop lambs had had only one summer period of poor, dry grazing.

The conditions and the length of time under which the experiments were carried out preclude any possibility that the test was not severe enough. The soil and grazing conditions at the two places studied were, as pointed out before, typical of large sections of the agricultural areas where sheep are run. At Wongan Hills the soils are of exceptionally low fertility, particularly in regard to phosphorus; at Merredin they are very much better but must still be considered poor in this factor. The 1935-36 summer and grazing conditions were very severe indeed at both Merredin and Wongan Hills. The 1936-7 season was only fair and the 1937-8 season again very poor. It is evident therefore that the conditions of the experiment were considerably poorer, rather than better, than normal for the areas concerned. It would be expected therefore that if any

benefit from the use of phosphatic licks were ever going to show up it would do so under these conditions. Furthermore the experimental sheep were carried through the dry summer period with a bare minimum of hand feeding. The only conserved fodder fed was ¾ to 1 lb. of cereal hay (containing approximately 0.15 per cent. P.) per head per day to the lambing ewes for 1-2 months in the autumn. The hand feeding was definitely below the levels consistent with good sheep husbandry whilst during the 1935-36 summer heavy losses of both ewes and lambs resulted from the very poor nutritive conditions.

A further point which requires emphasis is that the effects of the phosphate supplement were measured over four successive seasons, three of these with the same sheep born of ewes which had themselves been under experiment for a year previously. This distinguishes the present experiments from the previous work in Western Australia in connection with the botulism investigations in which different groups of sheep were used in successive years. It supports the earlier results showing that there is no sign of phosphorous deficiency in the long, dry summer period, either with young or old sheep and shows further that there is no evidence of a cumulative deficiency operating with young sheep over three years (two of them exceedingly poor) or with breeding ewes, either on the fertility or subsequent growth of wool yield of their lambs.

It is hardly necessary to point out that these results apply only with certainty to the drier agricultural areas of Western Australia. The results are such, however, as to make it difficult to conceive of any extensive areas either in this State or elsewhere in Australia where the use of phosphatic licks for sheep would be justified. Support for this statement comes not only from the very conclusive nature of the present experiments and those carried out earlier in this State, but from field and laboratory studies in South Australia and from the recent experiments conducted in Queensland. These experiments were carried out over a two year period under pastoral conditions representative of an extensive tract of country in the drier areas of western and north western Queensland. No benefit was obtained from the use of a phosphatic lick on the growth and development of lambs, on the lambing percentage or birth weights or on the wool production. It is evident that a considerable amount of money and effort has been and is being wasted by sheep owners in Australia in providing various forms of phosphate supplements to their sheep.

The above results raise the question of what are actually the P requirements of sheep. This matter cannot be appropriately discussed in this paper but the experiments of Martin and Pierce (1934) and du Toit, Malan and Groenewald, (1932) suggest that, for the merino at least, about 1 gm. P. per day must be considered to be very close to the minimum requirement, where the other dietary essentials are adequately supplied. Analyses of samples of herbage typical of the grazing in the drier agricultural areas of Western Australia and selected to conform as far as possible to the material actually consumed by the sheep (Underwood, Shier and Harvey, 1937) indicate an intake of about 1.0 gm. P per day in December and January, falling in normal years to about 0.5 gm. in March and April. These figures might be interpreted as indicating a short period of phosphorus deficiency but it is exceedingly difficult to know just what the grazing sheep actually consume and it is possible that they may obtain by a high degree of selection a somewhat higher P intake. Moreover the period of low P intake invariably coincides with a low intake of protein and frequently with a low intake of total available energy. Whether such deficiencies have the effect of lowering the sheep's P requirements is not at present known though it is perhaps significant that an appreciable lowering of the basal metabolism under such dietary con-

ditions has already been established (Lines and Pierce, 1931). In any case it is perfectly obvious from the present experiments that under Western Australian conditions at least the sheep can die of starvation before any sign of P deficiency becomes evident.

Finally, a word of warning should be given against thinking that the above results apply also to cattle. As Marston has already pointed out, the phosphorus requirements of cattle in terms of the concentration of phosphorus in the grazing are of the order of twice that of sheep. In W.A. evidence of phosphorus deficiency in the bones of cattle has been observed on a number of occasions by veterinary officers while low blood phosphorus values highly suggestive of phosphorus deficiency have been found not infrequently in the drier agricultural areas by one of us (Underwood, 1936).

Summary and Conclusions.

1. Experiments in the feeding of soluble phosphate supplements to merino sheep on two farms typical of much of the drier agricultural areas of Western Australia, carried out over four successive seasons, two of which were exceptionally poor, are described.

2. Although one of these farms was situated on soils of exceedingly low phosphorus status, no effect of such supplements could be demonstrated at either place on the body weights of mature ewes, the growth of lambs from these ewes, the birth weights of the lambs, the numbers of lambs born, the wool production of either the mature or the growing sheep or on the blood inorganic phosphorus levels.

3. It is concluded that no benefit, economic or otherwise, is brought about in the agricultural areas of Western Australia by supplementing the diet of grazing sheep with phosphatic licks and that the use of such licks by sheep owners is both unnecessary and wasteful.

Acknowledgment.

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Pedigree Seed.

CEREAL VARIETIES AVAILABLE FOR DISTRIBUTION.

I. THOMAS, Superintendent of Wheat Farming.

With all phases of agriculture it is important that the breeding stock, whether for animals or plants should be of the highest standard. Plant breeding, even more than animal breeding, is highly specialised and complex, and such work is confined to relatively few centres. From the labours of these few workers, farmers all over the world are enabled to maintain the standard of their seed stocks at a high level, and with the least amount of trouble and expense to themselves

Though many do not avail themselves of this service, those who do so soon realise the benefits to be gained thereby.

In this State the raising of pedigree seed is one of the main activities of the Research Stations, the principal breeding centres being at Merredin and Wongan Hills. Such wheats as Nabawa, Bencubbin and Noongaar produced by the Department are notable instances of this work.

When making available supplies of pedigree seed it is not suggested that a farmer obtain all his supplies of seed in this way, nor would it actually be possible for him to do so. It is recommended, however, that each year farmers should obtain a few bags of the variety or varieties they normally grow, sow this in a "Stud" plot or plots and then use the grain obtained for their seed requirements the following year.

It must also be realised that the supply of any one variety or varieties is not unlimited, and that as it is the aim of the Department to distribute the seed as widely as possible, it is usually found necessary to limit the number of bags of each variety per applicant so that this may be achieved.

The following may be of assistance to farmers in determining the quantity of seed required each year to maintain their Stud plots—each bag of pedigree wheat will sow four acres at 45 lbs. per acre and if the yield from that plot were 15 bushels per acre, the yield total being 60 bushels, which after grading will provide sufficient seed to sow 70 to 75 acres the following year at 45 lbs. per acre.

As a result of present seasonal conditions the quantity of pedigree seed produced will be considerably reduced but it is anticipated that this year limited quantities of the following varieties will be available for distribution.

WHEAT.

Baroota Wonder.—A late maturing variety, resistant to flagsmut, but is liable to rust. This variety is recommended for hay in the better rainfall districts.

Bencubbin.—A midseason maturing variety resistant to flagsmut, but is very liable to rust and is not recommended for those districts where rust is feared.

Bungulla.—A selection from Bencubbin, early maturing, drought resistant variety, resistant to flagsmut, susceptible to rust, but tends to be rust escaping on account of its early maturity.

Comeback.—An early-midseason maturing variety of premium milling quality. It is resistant to flagsmut and rust escaping.

Fedweb.—Late mid-season variety bred by Dr. W. L. Waterhouse of Sydney University. Short strawed, resistant to flagsmut and stem rust. Suitable for early planting in rust liable districts.

Ford.—A midseason maturing variety, resistant to flagsmut and rust.

Geeralying.—A very early maturing variety, resistant to flagsmut and rust escaping. It is liable to shed.

Gluyas Early.—An early maturing variety, resistant to rust but liable to flagsmut.

Merredin.—An early maturing variety, susceptible to flagsmut, but rust escaping.

Nabawa.—A midseason maturing variety, resistant to flagsmut and rust. Recommended for those areas where rust is feared.

Noongaar.—A very early maturing variety which is drought resistant, being most suitable for areas having a short growing period and for very late planting in those districts having a better rainfall; resistant to flagsmut and rust escaping.

Pusa IV.—Early maturing variety of high quality grain, moderately resistant to flagsmut, rust escaping on account of early maturity.

Sutton.—A late maturing variety, resistant to flagsmut and moderately resistant to rust. This variety is not recommended for areas of low rainfall.

Totadgin.—An early maturing variety; resistant to flagsmut.

Yandilla King.—Late maturing variety, moderately resistant to flagsmut and liable to rust. Not recommended for areas of low rainfall.

OATS.

Algerian.—A late maturing variety. Owing to slow early growth it is not recommended for early green feed.

Burts Early.—An early maturing variety which is especially suitable for hay, silage and early green feed.

Guyra.—A midseason maturing variety mostly favoured for its grain which is large and plump.

Mulga.—An early maturing variety suitable for hay, grain, silage and early green feed; superior to Burt's Early for grain.

Wongan.—A very early maturing variety which was produced at the Wongan Hills Research Station from a cross between Mulga and Burt's Early. It has short, strong straw and is suitable for early green feed and grain in the drier areas or for late planting in the wetter districts.

BARLEY.

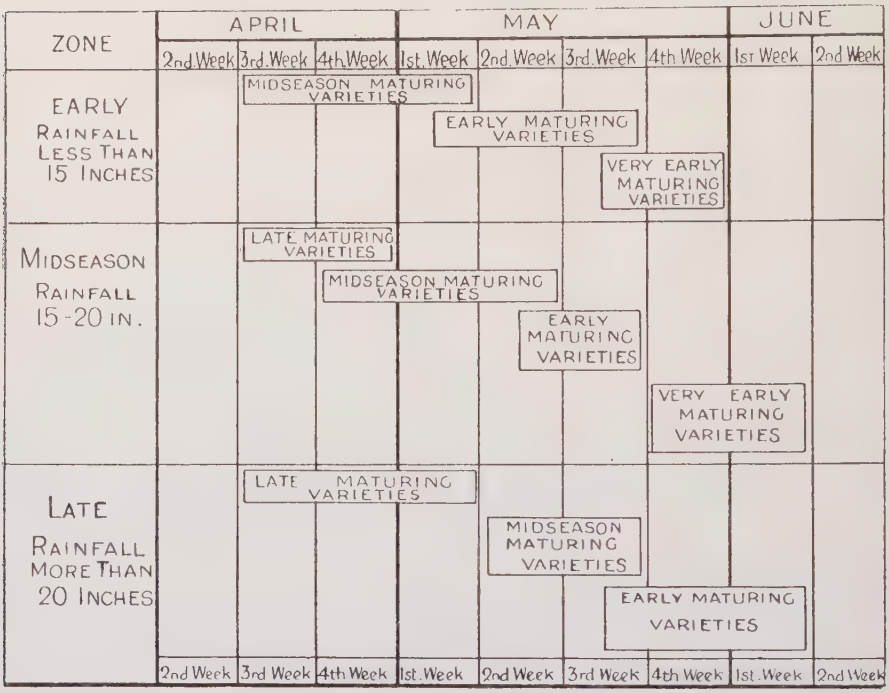
Atlas.—A six-rowed barley which has been introduced from California; it is also known in this State as Californian Six-Row Barley. In England it is used for malting purposes, but it is not employed for this purpose by local brewers whose technique is based on the use of two-row barleys such as Pryor.

It is recommended for green feed purposes, being superior to the other barleys and also the wheat, oat and rye varieties under general cultivation. It is also the most suitable six-rowed variety for export.

Pryor.—An early maturing two-rowed malting type grown mainly for local maltsters but is also satisfactory for green feed purposes.

Applications for pedigree seed should be made *direct* to the Department of Agriculture, Perth, and applicants are advised to make early application for their requirements, setting out clearly their name and postal address, together with the siding to which the seed is to be railed.

SEEDING CALENDAR WITH RECOMMENDED VARIETIES FOR THE WESTERN AUSTRALIAN WHEAT BELT.



RECOMMENDED VARIETIES.

Late Maturing.	Midseason Maturing.	Early Maturing.	Very Early Maturing.
Wheat—			
Sutton, Yandilla King, Baroota Wonder (for Hay) Fedweb	Bencubbin, Ford, Nabawa,	Gluyas Early, Merredin, Totadgin, Bungulla	Geeralying, Noongaar.
		Premium Varieties—Carrabin, Comeback, Pusa IV.	
Oats—			
Algerian	Guyra	Burt's Early, Mulga	Wongan.
Barley—			
		Atlas, Pryor	

Agricultural Problems.

Agriculturists, pastoralists and primary producers generally, who may be having difficulties of any kind in connection with their production activities, are invited to communicate with the Agricultural Adviser or Veterinary Officer of their district of the Department of Agriculture, when information and advice will be supplied free of charge.

Where identification of plant or stock diseases or insect pests is required, full details of symptoms should be forwarded and also samples of the diseased plant, animal tissue or insect where practicable. Plant tissue intended for examination by the Plant Pathologist should be wrapped in paper and not forwarded in airtight containers, and plant specimens for the Botanist should be pressed between newspaper and dried before despatch. With regard to animal tissue for microscopic examination, this should be forwarded in a solution of 10 per cent. formalin, or if of considerable bulk in a sealed kerosene tin containing a few ounces of formalin as a preservative. Living insects should be sent in suitable containers and dead specimens in methylated spirits.

The addresses and names of Advisers are as follows:—

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Bridgetown	A. M. Tindale (Dairying), A. Flintoff (Fruit).
Bunbury	M. Cullity (Dairying), A. F. Flood (Stock Diseases).
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Harvey	R. C. Cailes (Fruit).
Katanning	A. S. Wild.
Kalamunda, Roleystone ..	W. R. Jamieson (Fruit), c/o. Dept. of Agriculture, Perth.
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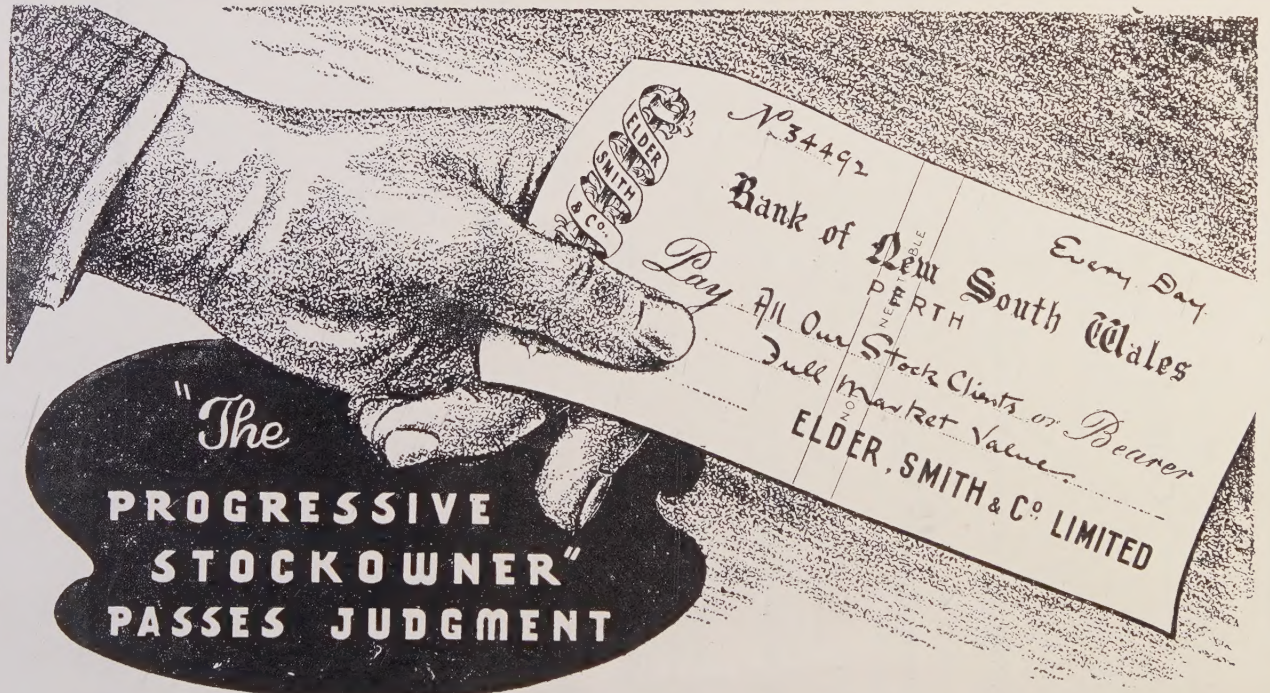

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